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PUBLIC WORKS.

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Western Avenue Tunnel Extension

Excavated in rock 622.6 linear feet daily per heading. Details of blasting, mucking, timbering and alignment. Mechanical equipment and concrete lining.

The Western Avenue tunnel extension, Chicago, to afford a water supply for the new William Hale Thompson pumping station, is 11 feet 4 inches wide and 12 feet high inside and is being driven about 33,000 feet through solid limestone rock from a gate shaft at State street and West 73d st. to another gate shaft at the intersection of Western ave., and thence on Western av. to 45th street.. It parallels the center lines of the streets on tangents, making a right angle at the Western ave. gate shaft and having the invert about 140 to 155 feet below the surface of the ground.

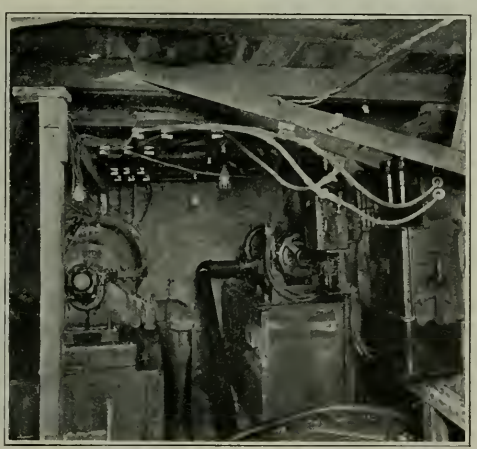
It has a cross-sectional area of 118.78 square feet and a perimeter of 40.16 feet, and involves a rock excavation of 6.0 cubic yards and a concrete lining of 1.6 cubic yards per linear foot. It has a capacity of 800,000,000 gallons per 24 hours at a velocity of 3.92 feet per second.

The total average force employed in the four headings is about 400 men.

The tunnel is being excavated simultaneously at four headings, two driven from the foot of a construction shaft at Wood street 4,000 feet from the Western ave. gate shaft and two from the foot of the 61st street shaft about 8,000 feet from the Western ave. gate shaft.

The work was commenced by sinking, in 1919, of the two construction shafts described in *Public Works,* page 477. The excavation was commenced in the first heading, driven in the foot of the Wood street shaft, in May 1920, and on the fourth heading in June 1920 and the excavation was 33 per cent completed November 15, 1921.

It is estimated that the two construction shafts, two gate shafts, tunnel excavation and pumps will require a total amount of 200,000 yards of excavation and 53,000 yards of concrete, will cost about $4,000,000 when completed and that the tunnel will be ready for service in November 1923. The work is being done on force account by the city of Chicago under Alexander Murdock, City engineer and Myron B. Reynolds, designing engineer, and the Waterworks Department, James J. Versluis, constructon engineer, and E. P. Scott and G. S. Samuels, resident engineers.



PUMP ROOM AT FOOT OF 61st STREET SHAFT

MINING AND MUCKING

The work is executed under atmospheric pressure and is carried on continuously with two 8-hour shifts in each of the four headings. The miners enter three hours after the muckers in each heading and for both headings, a total of 44 linear feet daily with a maximum record of 46 feet is secured.

The work is done by the regular top heading and single bench method, the full width top heading being about 7 feet high in the center and being drilled with from 23 to 30 holes 14 feet long arranged approximately as indicated in the diagram. The holes are driven in an average of 2½ to 3 hours actual drilling time, using bits from 2⅝ inches to 1¾ inches in diameter with a 1¼ inch steel.

The 10 "cut holes" are each charged with 15 sticks of 60% dynamite making a total of about 125-lbs. Nine or ten sticks are used in each of the No. 2 or "helper holes" and nine in each of the "rim holes" 4, 5, and 6, making a total of 400 to 450 pounds, explosive for the entire heading. The sticks weigh about 1 pound each and about eight sticks are generally used for charging each of the bench holes.

In the headings the blasts are fired with direct exploders for the cut holes, first delay for the helpers, second delay for the breakdown holes After examining the results of the blasts in the cut holes and noting the character of the rock exposed, the rim holes are loaded and fired direct or delaying as may be required. The bench holes are fired with the cut holes, direct for the front row and delay for the back rows. About 38 pounds of explosive is required for a linear foot of tunnel and produces from 10 to 11 yards of loose muck.

The drilling is done by four Ingersoll-Rand water liner machines mounted on two columns in the heading and by two Ingersoll-Rand water liners or piston drills mounted on tripods for the bench work. The rock is in irregular strata, separated by many clay seams from 1 to 2 inches thick, and is usually about 18 to 36 inches thick. The powder sometimes blows out in the seams requiring the holes to be recharged or redrilled.

MUCKING

For convenience in shovelling the rock is shot down on sets of three 3 by 12-foot floor plates ¼ inch thick, laid side by side a few feet in the rear of the bench. It is loaded by hand into 1-yard 24-inch gage side-dump cars, hauled in pairs by mules to the shafts and hoisted and delivered to the dumps in 6-car trains as described in the previous article.

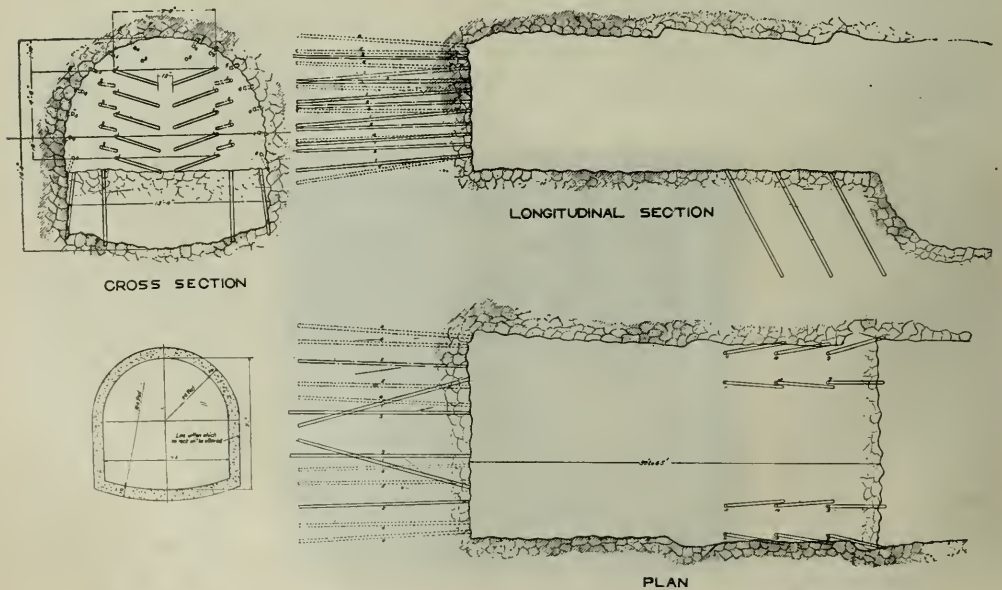
The rock from the headings is delivered by wheelbarrows on a platform extending about 20 or 30 feet beyond the face of the bench and supported on horizontal cross pieces about 6 feet apart and 7 feet above the tunnel floor, each consisting of telescopic 3-inch and 4-inch heavy pipes securely wedged in pick holes made in the side walls just below the spring line. At the rear end the wheeling platform is forked in a Y-shape so that the wheelbarrows can dump into cars on either of the two tracks below.

Generally the rock is sound enough to be safe without timbering, but in a few places where it is loose and treacherous the roof has been wedged up on 5-segment arch timbers, supported on longitudinal sills carried along the side walls on pairs of steel bars drilled into the rock at the spring line and thus obviating the necessity of vertical posts that would encroach on the narrow working space that barely suffices for the two service tracks.

The alignment of the tunnel is made from drill holes in the roof filled with wooden plugs in which are driven horse shoe nails with their heads drilled to receive the line of a plumb bob that is suspended in a three sided box painted white inside and illuminated by an electric lamp. The roof plugs are spaced about 75 feet apart and are checked from time to time with transit shots 1,000 feet long. Grade plugs are set in the side walls on the spring line at intervals of about 75 feet.

MECHANICAL EQUIPMENT

The tunnel slopes down on a grade of 0.2 per cent in both directions to the foot of each shaft where the seepage is collected in a 36 x 30-foot sump 11 feet deep which, under present conditions, will hold the drainage accumulated in about 16 hours. This water



LOCATION OF DRILL HOLES IN HEADING AND BENCH, ALSO CROSS SECTION OF COMPLETED TUNNEL

is pumped out at the Wood St. shaft by one 300-gallon Yeomans Bros. Co. pump, one 1200-gallon Lea-Courtney pump and one 8x10-inch Deane plunger pump. The large pump has a capacity sufficient to empty the sump in 40 minutes. Usually one pump only is run at a time and the others are held in reserve.

At the 61st st. shaft there are two 900-gallon Lea-Courtney motordriven centrifugal pumps with a lift of 185 feet. They are located in a pump chamber quarried out of the rock at the foot of the shaft. At each shaft there are installed two General Electric air compressors each with a capacity of 5,000 cubic feet of air per minute, which is delivered through a 16-inch pipe in the shaft and an 18-inch main in the tunnel. High-pressure air for operating the drills is produced by four Ingersoll-Rand motor-driven two-stage compressors with a capacity of 600 cubic feet per minute, each of them delivering to a pair of 6-inch pipes. Water pressure is delivered to the heading through a 3-inch riser line in each shaft.

The equipment at the Wood street shaft is similar to that above enumerated and the air for ventilation is delivered to the headings through 16-inch risers and two 18-inch tunnel mains made of 14-gage steel in 20 foot lengths with special gasketed flange joints. The general air supply for the tunnel ventilation is compressed to about 1½ pounds at the machine.

CONCRETE

The construction of the concrete lining has not yet been commenced, but it is planned to mix and place it in ½-yard batches, conveyed by pneumatic pressure with the same plant that was used for lining the Wilson avenue tunnel 12 feet in diameter and 8 miles long.

The lining will require about 53,000 yards of concrete, which will be made with stone provided by the tunnel excavation which will be utilized approximately as fast as delivered by the muckers without ever being carried to the surface of the ground. The method, operations, and plant for the tunnel lining will be the same as those adopted with the notable success and economy for lining the similar 8-mile Wilson avenue waterworks tunnel in Chicago that was completed by the waterworks department 5 years ago. As the lining constructed by this method can be completed about twice as fast as the heading excavation, operations will not be commenced until a later time, when the tunnel will have been about one-half excavated, as the rock then remaining to be mucked will more than suffice for the required amount of concrete and the lining can go on uninterruptedly to a completion about simultaneous with the finishing of the excavation.

STEEL FORMS FOR LINING TUNNEL WITH CONCRETE CONVEYED BY PNEUMATIC PRESSURE

The plant that was used in the Wilson avenue tunnel consists of four complete concreting outfits, two of which will be installed at the foot of each construction shaft and will advance toward their respective headings. In each outfit a screening and conveying apparatus, hoisting engine, pneumatic concrete mixer, compressed air tanks and concrete delivery pipe are installed on two detachably connected, long and narrow structural steel travelers, moving on one of the 24-inch gage service tracks on the tunnel floor and affording clearance alongside for the cars passing back and forth between the shaft and the heading.

FANS AND HOIST IN SHAFT HOUSE AT 61st STREET

The operations are identical for each of the four duplicate installations. Broken rock from the headings will be delivered in 1-yard side-dump cars that are hauled by an electrically driven hoisting engine to the top of a movable steel incline 15 ft. 3 in. long and thence over an elevated bridge to the rear of a screen traveller which has a 13-foot wheel base and a platform set 9 feet above the tunnel floor on which there is mounted a hoisting engine and an electric motor that drives a belt conveyor running to the top of a forward projecting cantilever arm 12 feet long.

The stone is discharged over a perforated steel plate screen through which all pieces less than 4 inches in diameter drop to an inclined conveyor and are continuously discharged at a height of 7 feet above the tunnel floor into a hopper above the pneumatic mixer. The hopper 3 feet 6 inches long is mounted with the

mixer and the air receivers, on a structural steel traveler with an 18-foot wheel base.

The hoisting engine is operated by a 10-h. p. electric motor and the belt conveyor is operated by a 3 h. p. motor driven at a speed of about 150 feet per minute.

The pneumatic mixer delivers into an 8-inch horizontal discharge pipe carried just above the tunnel floor on the center line of the service track. Through it ⅓-yard batches of concrete are delivered to any distance up to 1200 feet or more, and at variable elevations up to the crown of the arch. The mixer and conveyor are both operated by air under 80-lbs. pressure received from the regular tunnel supply main, and supplemented by the equalizing effect of the storage tanks on the traveller. The concrete is deposited behind 60 linear feet of Blaw-Knox steel forms that are stripped after the concrete is 12 hours old, the entire 60 feet being concreted and the forms removed in one 24-hour day. The concrete plant is shifted every 700 or 800 feet.

The concrete mixer is of very simple construction, consisting simply of a conical receptacle the upper part of which is open to receive the charge and then closed to receive the air pressure, which forces the batch through the delivery pipe. It is believed that the passage of the batch through the pipe promotes the mixing. It sometimes requires as much 1,500 cubic feet of air per minute. The large pipe works satisfactorily and clogs only occasionally when the concrete passes through standard elbows instead of long-radius curves. At the shortest bend the wear on the interior pipe surfaces is severe, requiring renewals every few weeks.

FORWARD END OF PNEUMATIC CONCRETING PLANT

Importance of Restricting Motor Truck Loads

After having spent $600,000 in one year for the repairs of roads injured by excessive loads on motor trucks the State of Maryland in 1920 amended the motor vehicle law, limiting gross loads to 20,000 pounds, and the maximum load per inch width of tire to 650 pounds, maximum width of truck to 90 inches, maximum rated carrying capacity to 5 tons, and maximum speed per hour to a sliding scale varying from 25 miles for a 2-ton gross load to 12 miles for a gross load exceeding 6 tons. The truck load is also limited to its rated capacity.

The load clauses of the law are enforced by officials operating permanent road scale between Baltimore and Philadelphia and another on the Baltimore-Washington Boulevard and by an inspection party consisting of two inspectors, two laborers, a uniformed policeman and equipped with four loadmotors (portable jacks) in a light automobile that travel about on the different state roads, stopping and weighing any trucks that appear to exceed the load limit. A loadmeter placed at each wheel lifts the truck entirely free of the ground and indicates the exact gross load while running the tires over a white paper. Carbon paper and smooth steel plate gives an accurate imprint of the bearing width of the fire.

In the first week of their application, in September 1920, 60 trucks were fined from $10 to $100 each for overloading, in the second week on different routes 70 trucks were caught after which, inspectors changing their positions irregularly discouraged over loading so much that in the sixth week only one truck was found to be overloaded and loads of more than 10 tons have now practically disappeared.

At first the fines imposed did not deter some shippers from continually overloading their trucks when they were allowed to carry the excess load to the nearest railroad station and reship it, but when they were compelled to discharge the excess by the roadside and send another truck out to pick it up the practice was soon abandoned.

There are 1700 miles of road in the Maryland State Highway system and since the prevention of overloads the chief engineer of the State Highway System reports that there has not been a single road failure and he estimates that the extra cost to shippers of reducing heavy unit loads of 5-ton trucks would not have been more than $15,000 if applied to the loads that had done $600,000 damage to the Maryland system. It had previously been found that a $500 yearly registration fee did not keep 7-ton trucks from the highways and the present policy is not to deny the highways to motor trucks, but rather to restrict the latter in the interest of economical highway transport so as to give the entire state the highest operating value for the highway system.

Wood-Stave Water Pipe

A summary of the results obtained by its use in U. S. Reclamation projects during the past twenty years.. Comparison of fir and redwood, buried and above ground.

In November 1920 the chief engineer of the U. S. Reclamation Service sent a questionnaire to managers of all the reclamation projects asking for information regarding wood-stave pipe installations, this information including such data as the location of the pipe, the diameter and length, whether built of redwood or fir, whether machine banded or continuous, the maximum head on the pipe, whether it was buried or above ground, the date when it was installed, and its present condition.

Data were supplied by eighteen separate projects covering 196 separate installations. As eighteen men contributed the information, their use of the general terms descriptive of the condition of the pipe such as "perfect," "no good," etc., varied as the personal equation varied. In tabulating the answers the general office used its best intelligence to classify these under the descriptive terms used by it of perfect, excellent, very good, good, fair, poor, very poor, bad, almost useless and no good. After tabulating the data under these classifications, these terms were further grouped under two headings, "fair or better" and "poor or worse." It is thought that all pipe described by the former is still giving satisfactory service, while that given under the latter head was not giving satisfactory service at the time of the examination although it may have been doing so shortly before that time.

From a study of the data a few general conclusions were drawn, which are published in the December issue of the "Reclamation Record" as follows:

1. One condition which, while not universal, is in general quite typical of the operation of pipe lines in the Reclamation Service is that they are full of water only part of the time. This condition is generally recognized to be conducive to the early decay and destruction of wood pipe.

2. Many installations of wood pipe in the Reclamation Service are in soils that are more or less heavily impregnated with alkali and carry alkali-laden water. This contact with alkali appears to have resulted in several instances in the early destruction of the steel bands and wire winding of the pipe.

3. There are 65 installations reported as being made between the years of 1916 and 1920, all but three or 95.4 per cent of which are reported as in fair or better condition. The three installations reported in poor or worse condition were made in 1916 and 1917 and were of untreated fir staves placed in moist earth and kept full of water during the irrigation season only. They were in sizes of 10 to 12 inches and are under maximum hydrostatic heads of 10 and 15 feet.

4. Of the 59 installations made during the period of 1911 to 1915, inclusive, 50, or 84.7 per cent, are reported as in fair or better condition. Of the 9 in this group reported as being in poor or worse condition, 2 are of untreated fir in moist earth, full during the irrigation season only, 1 is redwood buried in alkali soil that has destroyed the winding, 2 are untreated continuous fir laid in gravelly soil, and 4 no information is at hand as to nature of soil or continuity of service.

5. Of the 71 installations made during the period of 1910 and earlier, 54, or 76 per cent, are reported in fair or better condition. There are 3 installations made in 1901 and 1 in 1904 which are all the installations reported as being made prior to 1905. All of these are reported to be in fair condition, although all are reported as having been moved and relaid.

6. Of the 29 installations of all periods reported in poor or worse condition, 18 describe no circumstance surrounding their construction or operation that might be taken as the reason for their unsatisfactory state. The remaining 11 installations record reasons such as "full during irrigation season only," "installed in gravelly soil," etc., that might be considered as causes for their failure, but which are also reported as existing in connection with installations giving satisfactory service. So the evidence is not conclusive as to why these installations have failed.

7. In stating the probable life of wood-stave pipe installed and operated under average conditions existing on the projects of the Reclamation Service, as indicated by these data, it is probably safe to say that there is an even chance or better that with some maintenance an installation will give 15 years of satisfactory service and that if unfavorable conditions are avoided there is a reasonable certainty that this satisfactory life will be not less than 10 years.

8. Reported conditions that apparently have tended to shorten the useful life of the pipe lines may be stated as follows:

(*a*) Intermittent service, pipes full of water during the irrigation season and empty during the non-irrigating season.

(*b*) Installations made in gravelly or open soils.

(*c*) Installations made in alkali soils resulting in destruction of the bands and wire winding.

(*d*) Installations using separate wooden collars at joints. These collars tend to rot out while the pipe proper remains in good condition owing evidently to the fact that the collars are not so thoroughly saturated in service as the walls of the pipe.

(*e*) Installations under low hydrostatic heads—say less than 15 feet—which are not sufficient properly to saturate the wood.

The tabulated data show that, considering all installations of all ages, about one-third of the wire-wound fir staves that had been buried and about 2% of such pipe that was laid above ground, were now under the "poor or worse" class. Of the wire-wound redwood staves, all of which were buried, only about 1 1-3% were in the "poor or worse" class. Of the continuous fir staves which were buried, about 25% were under the "poor or worse" class, while of those that were above ground about 22% were in that class. The continuous redwood pipe had not been laid upon reclamation projects prior to 1916, and of the 450 feet buried and the 10,608 feet laid above ground all was still in the "fair or better" class.

Winter Protection for Contractors' Machinery

Road officials should make every effort to get all road equipment which is not in use under shelter for the winter. More damage is ordinarily done to graders, tractors and other road machinery by standing out through the winter entirely unprotected than by the actual usage during the road building season. Not only should all machinery and equipment be put under cover or protected from the sun, rain and snow but every piece should be thoroughly oiled and greased on all uncovered metal parts. The winter time should be the time for making all general repairs, overhauling the engines, securing of all new parts needed and laying in whatever stock or repair parts experience shows to be necessary for the county season's work. A few gallons of paint properly

applied means hundreds of dollars saved during the year. The winter time is the proper time to do the painting. The work on the repair of the county machinery should provide employment for the foremen and best men in the county crews, so that the experienced men can be retained and the county not be put to the expense of training up new foremen and entirely new crews when the season opens. This work can only be done with the machinery and equipment under cover.

—*Iowa State Highway Commission Service Bulletin.*

Sensitive Detection of Suspended Matter

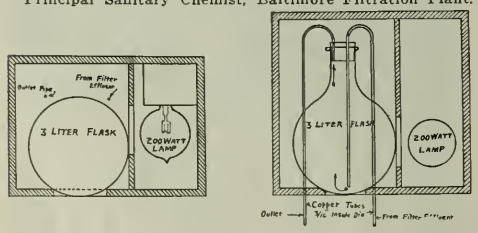
By John R. Baylis*

A device for detecting turbidity and suspended particles in the effluents of filtration plant, used especially to detect breaks in the filter mat.

In operating the Montebello rapid sand filters in Baltimore, the engineers have realized for several years that it was desirable to detect turbidity and coagulated particles in quantities more minute than the ordinary laboratory methods made possible, the chief object being to detect breaks by small particles of floc passing through in suspension or by a cloudy appearance due to unclarified water passing through the break in the filter. It was suspected that in some cases the settlement of matter in the mains which had passed through breaks in the filter mat have been incorrectly attributed by the operators to secondary chemical reactions. At any rate, it is believed that floc passing the filters will settle and accumulate in mains and reservors and be occasionally picked up by temporarily increased velocities and make turbid the water delivered to the consumers.

About two years ago efforts were made at the Montebello filters to design a device that would detect immediately any turbidity or presence of coagulated particles, this device to be applied to the effluent from each filter. The first plan tried was to pass a small portion of the effluent water through a 3-inch pipe set vertically with a light at the bottom, the water passing vertically upward through 5 feet of pipe and discharging at the top. This was not a success, chiefly because it was not possible to bring the eye near enough to the slight suspended particles to be within ordinary reading distance 12 to 18 inches. Moreover, the light illuminated the bottom of the particles instead of the tops which were visible.

*Principal Sanitary Chemist, Baltimore Filtration Plant.



PLAN SECTIONAL ELEVATION

APPLIANCE FOR DETECTING MINUTE SUSPENDED MATTER

The illumination of dust particles in a dark room by a ray of sunlight suggested the passing of a ray of light through the water approximately at right angles to the line of sight of the observer, and provision for bringing the eye to within 12 to 18 inches of the column of water under observation.

A number of different ideas were tried out and a device was finally perfected which is now being used with success. In this device a spherical flask filled with water gives a magnification of approximately two diameters on the side opposite the observer, so if such a flask is used it must be placed where the opposite side is the proper distance from the eyes. The best condition for the light is at such an angle that none of the rays will strike the eyes or any surface that will reflect the rays, except the particles in suspension. This latter condition can only be approximated, but sufficiently so for our use.

It was thought best to use spherical flasks for the present, due largely to their cheapness. The best position of the light was found to be at an angle of from 90 degrees to 120 degrees to the line of sight. The device as finally constructed and put in operation consists of a 3-liter round-bottom pirex flask, with two small copper tubes about 3-16 of an inch inside diameter entering the flask through a rubber stopper. The inlet tube extends nearly to the bottom of the flask while the outlet tube stops just below the bottom of the stopper. The flask is set in one side of a wooden box, on the other side of which is a 200 watt lamp. Between the flask and the lamp is a partition and in this is a hole about 4 inches in diameter which allows the light from the lamp to pass into the flask at an angle of between 90 degrees and 120 degrees with the line of sight of the observer. In one side of the box is an observation hole about 3 inches in diameter.

The devices (now preferably mounted in a metal rather than a wooden box) are mounted on the marble operating tables, and a switch on the side of the table enables the operator to turn the light on or off.

The copper inlet tube is extended about 25 feet to the point where it receives the filter effluent before this passes through the filter rate controller. Water is drawn through the flask by siphon action, the effluent pipe extending about 2 feet below the lowest level likely to occur in the filter effluent. At the Montebello filters the flow through the flask is at the rate of about 100 gallons in 24 hours. Siphoning can be started by drawing the air from the outlet pipe by either the mouth or a vacuum pump. It is necessary that the outlet tube be sufficienly small to produce a velocity that will carry out any air bubbles present in the flask.

With this device it is possible to detect the presence of particles that would not cause a turbidity of 0.01. A single particle of floc in a liter of water can be seen readily, the light conditions and magnifyng effect of the side of the flask making visible smaller ones than could be deteted under ordinary conditions.

The device of course does not give any quantitative

results, although a series of comparisons with samples of determined turbidities would probably enable an observer to estimate turbiditity approximately; but it does permit the detection of particles that would hardly be discovered by analytical methods, and makes the discovery immediately so that prompt action can be taken to remedy the condition of the filter.

(Under date of January 2nd Mr. Baylis writes: "This is the time of year we need the turbidity detector most and it has proven very useful. We are washing filters with loss of head ranging from 2½ to 8 feet. It will open the eyes of many filter operators and will stop considerable talk about after-precipitation or incomplete chemical reactions until after filtration.")

Military Equipment for Road Building.

The War Department has turned over to the Department of Agriculture $150,000,000 worth of surplus war materials to be distributed through the Bureau of Public Roads for road building purposes. The largest items were for New York $5,509,520, Illinois $5,462,400, Texas $7,101,240 and Pennsylvania $4,384,600; only seven of the states receiving each less than one million dollars worth of road equipment.

Taxes on Motor Vehicles

It is reported that during 1921 federal, state and municipal taxes on motor vehicles amounted to a total of $316,720,000 which is equivalent to an average of about $34 per car.

Prevention of Misuse of Sewers

Failure of municipal official to properly control establishment and use of connections results in impairment of efficiency of sewerage and sewage treatment systems and generally unsatisfactorily results.

By W. H. Dittoe*

The purpose of this discussion is to call attention to the abuse of sewerage and sewage disposal systems resulting from failure of municipal officials to control properly the establishment and use of connections to sewers. Sanitary engineers generally have deplored this condition of affairs and as a class are in agreement that better control should be provided. However, sanitary engineers have been prone to leave entirely to municipal officials the solution of this problem and with few exceptions have failed to recognize that it is essentially their duty to take the lead in establishing proper control. This discussion will attempt to show that sanitary engineers must not only recognize the importance of preventing abuse of sewerage and sewage disposal systems, but must actually undertake the problem of prevention if the expected efficiency of such improvements is to be realized.

One of the most important factors reducing the efficiency and value of systems of sewerage and sewage disposal is the misuse of sewers. Sufficient emphasis has not been placed upon this subject and rarely is it found that a municipality enforces a strict policy regarding the use of sewers. Considerable effort is expended by engineers in designing sewerage systems and sewage disposal works and as a basis for such design the volume and character of the sewage flow must be known or estimated. Therefore, if these factors are disturbed appreciably the improvements will not be used under the conditions for which they were designed. The result will be a shorter life of the system as a whole, impairment of its efficiency and generally unsatisfactory results. The misuse of sewers is also an important fault affecting the successful operation of sewage disposal works and hence the problem of prevention of stream pollution. It is useless to design sewerage improvements upon an assumption that certain maximum rates of flow will occur and that the sewage will be of a certain character unless the construction of such works is followed by the enforcement of a definite policy which will insure against exceeding such rates or changing such character.

Sewers are designed for definite purposes and when used for other purposes may be said to be misused. Storm drains are misused if they received sewage, industrial wastes, or other waste of objectionable character. Combined sewers are properly used for the removal of practically all classes of liquid wastes but are misused if they receive industrial wastes affecting the sewerage system or process of sewage treatment. Sanitary sewers, as the name implies, are for sanitary purposes only and are misused if they receive drainage from the surface and roofs, subsoil drainage such as may be admitted by building foundation drains and through open or leaky joints, and industrial wastes of a character to affect the sewerage system or treatment process.

The effect of the misuse of sewers is frequently quite serious. Sewage discharged into storm sewers causes nuisances at outlets and offensive odors through street inlets. If such practice is permitted, the benefits to be expected from a separate sewerage system are not realized. The admission of surface and subsoil drainage to sanitary sewers overtaxes the sewerage system, resulting in cellar flooding and damage to sewers, and overburdens pumping equipment and sewage treatment works necessitating by-

†Paper before Symposium on Steam Pollution and Sewage Disposal arranged by the Am. Soc. of Civil Engineers.

*Chief Engineer, Ohio State Department of Health.

passing of the flow, impairing the efficiency of the plant and frequently causing rapid deterioration. Industrial wastes discharged into sewers often cause sewer clogging or may actually destroy the sewers if the wastes have solvent properties. Many industrial wastes also interfere seriously with the efficiency of sewage treatment plants.

Of the more troublesome industrial wastes may be mentioned: Wastes from tanneries and glue factories containing hair and lime; wastes from textile industries containing cloth, fibrous material and objectionable compounds in solution; wastes from canning factories containing vegetable particles; wastes from stockyards containing manure; wastes from packing plants containing animal offal; gasoline wastes from garages; acid wastes from metal industries; wastes from milk industries and gashouse wastes. Such wastes should be treated properly prior to their discharge into the public sewers or should be excluded entirely.

It seems apparent that the evils resulting from misuse of sewers are of sufficient importance to warrant a real effort to prevent it. It has been accepted by many engineers that the misuse of sewers, particularly sanitary sewers to carry storm water, is inevitable and cannot be prevented, and this conclusion has produced a strong argument for the selection of the combined system. It is true that the combined system can rarely be misused and that from this standpoint it is preferable. However, it does not appear sound to conclude that it is impracticable or impossible to secure proper use of separate systems. In fact separate systems now existing will continue in use and new systems will be built; therefore, engineers and city officials cannot avoid the responsibility for securing their proper use. The industrial waste menace is present and must be controlled regardless of the kind of sewer system used.

It is obvious that the proper use of sewers cannot be secured without strict enforcement of ordinances and regulations by the proper municipal officials. The sewer contractor and the property owner cannot be expected to realize the importance of using sewers properly and for the purposes for which they were designed to function, and therefore they must be controlled in order that the public may not suffer from their mistakes. Ordinarily, municipal officials themselves do not appreciate the necessity of protecting sewers and sewage treatment plants from abuse, and therefore are not in position to initiate suitable regulations. It seems apparent that it becomes the duty of sanitary engineers to dictate such regulations and to see that they are adopted. This function of the engineer is as important as the design and supervision of construction of the improvement and if it is not performed it may truly be said that the work of the engineer has not been complete. Ordinarily, the engineer who has designed and supervised the construction of a sewerage system and a sewage treatment plant furnishes definite instructions in regard to the operation and maintenance of the system and he should likewise furnish a definite program for preventing misuse which may defeat the purpose of the improvement.

Many municipalities have satisfactory ordinances and regulations but fail to enforce them. Such ordinances usually require permits for connections to the sewers and provide for inspection of the connection by a representative of the municipality after the contractor has completed the construction work and before the trench is filled. Theoretically this control should be sufficient but too frequently the results are far from satisfactory. In many instances the construction work is faulty, joints are made imperfectly and so admit ground water to the sewer, the inspection is neglected or performed carelessly, improper wastes are admitted, and no proper record of the connection is maintained. When this system of control is started improperly it is very difficult to correct it and make it efficient and usually the conditions become worse rather than better until the sewer system is generally abused.

It seems necessary that municipalities provide a more immediate and direct control of the use of sewers if sewerage systems are to be managed and maintained as they should be. The most logical and effective method of accomplishing this is the construction by the municipality of all connections to the public sewers from the building to the street sewer and the continuation of municipal control over such connections after they are constructed. The sewer department would organize its construction gangs for this work or would enter into annual contracts with responsible contractors, and the property owner would pay to the city the cost of construction, inspection and recording.

When local treatment of industrial wastes is necessary to protect the sewerage system or sewage disposal works, such treatment would be provided by the industry and the effluent received into the sewer system under proper control. The connection could be equipped with an inspection hole to permit subsequent examination by the sewer department of wastes discharged through it and discharge of prohibited wastes could thus be detected. It is believed that this method of installation would insure better construction of the connection at lower cost, would largely prevent the misuse of sewers, and would assist in securing efficient operation of sewage treatment processes. Incidentally it would probably arouse a more lively interest on the part of the city officials in the management and maintenance of the sewerage systems and would likewise remind the public that the system is an important feature of the community development and must be controlled in a business-like manner if its value is to be realized.

Illness from Sewer Gas.

In England, as in this country, sanitarians are generally agreed that sewer gas is not an immediate cause of disease, but in spite of evidence to this effect by English specialists, an English court has awarded damages against the city of Liverpool and in favor of a plaintiff who stated that he and his family of four children were made very ill by sewer gas which was caused by the neglect of the city's workmen in leaving cleaning rods in the sewer near their house, as result of which the sewer was blocked. Altogether the court awarded this family over $2,000 damages with costs.

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The First Annual Report

For several years past we have noted in these columns the first annual report to reach this office. Naturally the earliest reports are those which are sent in typewritten form rather than the printed reports. We also find that reports of individual departments can always be gotten out more promptly than publications containing the combined reports of all departments, since there seem always to be one or two departments in each city whose dilatoriness holds back the publication of such combined reports.

This year we received a report for the year 1921 on January 3rd, the first day of the new year in which mail was delivered. This report was that of W. P. Cottingham, city engineer of Gary, Ind., for the past four or five years and re-appointed by the incoming administration.

This report includes tables showing the street and alley work done during the year and the one sewer contract awarded during the year, together with a summary of this work. These show that about 124,000 square yards of reinforced concrete and sheet asphalt pavements and 5,116 square yards of sidewalks were laid at a total cost of $503,147; and 22,676 square yards of concrete alleys at a cost of $77,514, and sewers to the extent of $10,590. During the four years of the present administration the improvements carried out by the engineering department have totaled nearly $2,000,000.

On special assessment improvements, the engineering and inspection charges are included and are returned to the general fund when the assessment has been collected. During 1921 the engineering and improvements carried out by the engineering department concrete streets, 2.53% on asphalt streets, 2.87% on concrete alleys and 2.42% on sidewalks.

Co-Ordinating State Construction

For many years there have been perennial efforts, more or less perfunctory, to unify federal construction operations. National construction work has been distributed through almost all of the principal departments of government so that its closely allied operations are conducted simultaneously in the War, Treasury, Agricultural and many other departments resulting in a conflict of authority and standards, in opposing plans, in unnecessary multiplication of organization and equipment and in inevitable waste delay, uncertainty and other kinds of inefficiency, that it is believed could be greatly diminished by the establishment of a department of Public Works to handle all construction matters.

Similar conditions prevail in some of the states and in New York State public construction is at present distributed through the departments of Public Work, State Engineering, Highways, Public Buildings and the office of the State Architect. These departments have thousands of employees and execute hundreds of millions of dollars worth of work, some of it to considerable disadvantage, that if corrected, might well effect the reduction of ten million dollars that Governor Miller wishes to make in next year's expenditures.

The conflict of authority, duplication of officials and employees, divergence of plans, interference of operations, uncertainty of standards, jealousy, delay and waste are inevitable, especially in politically effected work where the same undertakings may reach into several overlapping departments with varying standards, traditions and habits.

It is obvious that great advantages would be obtained by reorganizing all of the present construction departments under one which should be that of the State Engineer, co-ordinating all operations and interests and maintaining separate bureaus for special classes of work, such as public buildings, highways, conservation, river and harbor work and the like under uniform direction that would eliminate many duplications and all conflicting offices and operations and establish definite responsibilities and combined resources that will make for quicker, better and cheaper results, which if they secured only the very conservative saving of 10 percent in present costs and time, would soon amount to many million dollars for New York State.

Refuse Disposal and Street Work in Newport

A contract for collecting and disposing of the refuse of the city of Newport, R. I., held by Moses David, expired on January 4th of last year and, following an advertisement for bids for this work, the contract was let to C. V. Strona to make collections by auto truck for $44.85 a day. After about a month's trial Mr. Strona cancelled his contract and the aldermen then awarded a contract to David & Dannin at $64.75 a day. This arrangement continued until April 17th, when a contract was made with this firm for three years at the rate of $19,250 a year, providing the representative council appropriated each January a sufficient amount to cover the contract. The appropriation for collection and disposal for last year was $20,400, of which only $19,351 was spent.

The city has several dumping places along low land and two men are employed constantly on the dumps to level off the material delivered. Last year the total expenditure for this labor was $2,606.

The city kept a record of the amount of material collected and the average per day for each of the several months varied from a minimum of 43 tons per day in March to a maximum of 71½ in December, except for May, which clean-up week brought up to an average of 93 tons. The total amount collected during the year was 17,196 tons. (The population of Newport is a little over 30,000, this giving the average refuse per capita as about 1,100 pounds for the year.)

In cleaning streets, 4 foremen and 29 men with 5 carts were employed on macadam streets and all others except those with durable pavements, while on the latter 11 men and 3 carts were employed throughout the year except when the streets were covered with snow. There were 2,484 miles of cleaning of streets with durable pavements, containing 41,581,000 square yards, and these were cleaned at a cost of $22,189, or an average of about 55 cents a thousand square yards. When the costs are given by streets, however, it is found that the cost per 1,000 square yards for the different streets varies from a minimum of 22 cents to a maximum of $1.14.

In sprinkling the streets, Street Commissioner John F. Sullivan used both horse-drawn sprinkling carts and a motor truck sprinkler, the latter beginning operations on April 12th and continuing in use until November 6th, while the horse-drawn carts were retired on September 6th because the appropriation was exhausted. During the 7 months that the motor truck sprinkler was in operation it used 713,000 gallons of salt sea water in sprinkling 566 miles or 8,709,000 square yards of street, and applied 275,000 gallons of fresh water on 199 miles or 3,184,000 square yards. The total cost of this work was $6,953. The motor truck sprinkler went into service in 1919 and took the place of 7 horse-drawn carts.

Commissioner Sullivan, among his numerous duties of street commissioner, also has charge of spraying trees with a view to exterminating the elm beetle and tussock moth. Last year post cards were sent to all persons whose trees had been sprayed by the city the year before asking them to advise the department if they wished the work done again. 296 citizens requested the city to spray 2,557 trees and this was done at a total charge of $1,290. In addition, 4,985 city trees were sprayed, making the total number sprayed 7,542. The total expenditure for this service was $3,192 or, about 40 cents per tree—about 10 cents less than was charged the private citizens for spraying.

Unusually Complete Sewage Purification

The effluent from the Cowley sewage disposal works at Uxbridge in the London, England, metropolitan district, is discharged into a stream used for the London water supply and every endeavor has been made to produce the best practicable effluent. The plant has a capacity for 125,000 gallons of sewage per day, estimated to be the dry weather flow from 5,000 population.

There are three sedimentation tanks with a capacity of one day's dry weather flow, two of which would be in use and one empty when the population is normal, the third being used as a reserve and to permit of cleaning, repairs, etc. The effluent from these tanks is conveyed to a dosing chamber where a siphon discharges it onto two primary filters. Each primary filter is 74 feet in diameter and 5 feet deep and surrounded by 9-inch walls. The bottom is covered with tiles three inches high provided with drainage holes, on which is laid the filtering medium which is composed of granite, clinker, and slag graded from two inches diameter to one inch. The sewage is distributed on the surface of the filters by means of rotary distributors.

The effluent from the primary filter is conveyed to a second dosing chamber and discharged by it onto two secondary filters, the filtering medium of which is graded between 1½ inches and 1 inch. The effluent from the secondary filters flows into two humus tanks. After leaving in these tanks the suspended matter from the filters, the effluent is conveyed onto four sand filters 18 inches deep for final treatment before being ultimately discharged into the river Pinn, a tributary of the Thames. These sand filters are cleaned by forcing wash water upward through them, the water being pumped from a small storage tank by means of a gasoline-driven pump. The sludge from the humus tanks is removed onto drainage beds constructed in the adjacent gravelly soil. The sludge from the sedimentation tanks is discharged into trenches in the land and covered with the excavated material.

From the time the sewage is discharged into the sedimentation tanks until the final effluent reaches the stream, all parts are entirely automatic in action as far as possible and the plant requires little beyond cleaning and removal of sludge. The engineers for this plant were D. Balfour & Son of London. This plant was visited a few weeks ago by members of the Association of Managers of Sewage Disposal Works of England. In exhibiting the plant, Mr. Balfour stated that his firm had constructed 178 similar installations for the government, the aim in each case being to make the plant as perfect and as automatic in its working as possible, so that the man in charge might even remain away for a week and the purification of the sewage continue in a satisfactory manner.

Maintaining Street Car Traffic Over A Fire Hose.

Recently traffic was maintained by the Los Angeles, Calif., street railway cars over a line that was obstructed by a fire hose in service, by the use of a simple expedient that protected the hose and prevented car blockade on both sides of it. Where the hose crossed the track it was passed through openings in a pair of special steel bridges that were set on the track rails and provided inclines over which the street cars, hauled by a 2-ton White truck, passed safely over the hose without injurying it. The bridges were of simple heavy construction, consisting of pieces of rails connected by a center panel bolted to them and making a portable device that can be quickly placed in position and quickly removed whenever required.

The truck shown in the illustration is frequently used for emergency work, which often consists of hauling a derailed street car back on its track. The truck is also equipped with a three section telescope tower, designed to facilitate the repair of overhead wires and is provided with an equipment of blocks, tackle, picks, shovels, crowbars, ropes and the like, making it efficient for general emergency and wrecking work.

Concrete Construction "Kinks"

The "Dixie Highway" recently described a number of "kinks" which had been used by contractors in the construction of concrete roads during 1921, which indicate that American road contractors will never reach the end of their resourcefulness in devising new methods for meeting every new condition or for the securing of greater efficiency under old ones.

In loading trucks or wagons with sand and broken stone aggregate it is common to have a measuring box under a bin of each material and, having discharged into the truck the proper amount of one class of aggregate to drive under the other box and receive the proportionate amount of the other aggregate. One contractor built the two bins upon a single trestle with a driveway under the sand bin only. Only one measuring box was used, which ran on rails fastened on the trestle posts that support the bins. When the desired amount of stone had been discharged into the box, it was readily run on these rails by one man to a position under the sand bin and over the truck, where it received its charge of sand, and both aggregates were then discharged into the truck, which thus neither had to pass through one bin to the other nor to wait while two measuring boxes were being filled.

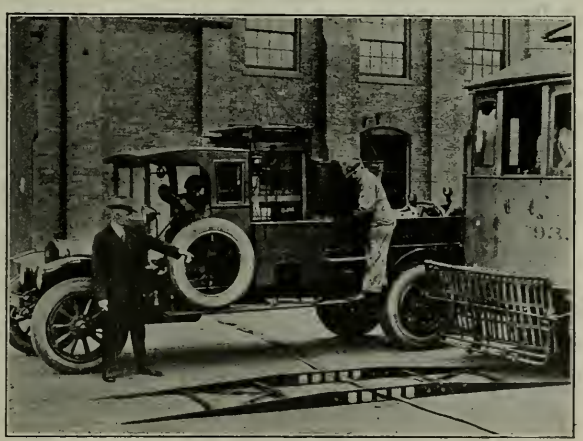
In Collingswood, N. J., a central mixing plant for laying concrete pavement was located against one side of a retail coal elevator. Bins inside the elevator were filled with the aggregates by a coal handling apparatus and discharged them into measuring boxes over the mixer by means of chutes passed through the wall of the elevator house. Cement was taken to the loading platform by a small elevator. The mixer was elevated above the ground and discharged directly into a truck.

Another contractor, being in immediate need of side forms for a concrete road and being unable to obtain fabricated steel ones promptly, managed to get along with wooden ones made as follows: The vertical face was made of 2 by 6-inch timber and the bottom piece of 2 by 3 timber, the two being braced together b ytriangular blocks, three of which were fastened in each 10-foot section, one of the blocks extendng beyond one end of the section to form a splice with the adjoining section. Three holes were bored in the bottom or flange piece of each section and three steel pins bent over at the top were driven through these holes to hold the form in place. A light steel channel or strap was fastened to the top of the vertical plank, forming a running surface for the finishing machines.

Was Sedimentation Basin Necessary?

The U. S. Bureau of Public Health has abstracted a report for the year 1910 of the water works of Rotterdam, Nevertherlands, which contains some rather interesting figures. One of these is the per capita consumption which increased from 19 liters per capita in 1875 to 224 liters in 1893 declining to 163 liters in 1898 to 1907, when there was a sharp decline to 99 liters due to a campaign against waste in which metering played a part.

Perhaps the most remarkable figure given is that for the collection in the sedimentation basin. The water is treated by sedimentation in two basins followed by slow sand filtration. Basin No. 1 was not cleaned between 1890 and the end of 1909, or more than 19 years. At the latter date the water was drawn off and the depth of deposit was found not to exceed 1.1 meter at any point. In the second basin there was a vigorous growth of water plants, but following the cleaning of basins No. 1 the plant growth was much reduced, the absence of the thick clumps of batrachium of former years being especially noticeable.



MOVING CAR OVER BRIDGE THROUGH WHICH HOSE PASSES

Organization of Metropolitan Districts

Report of the sub-committee on sewerage of the American Society for Municipal Improvements, comprising Langdon Pearse, chairman, George G. Earl and C. M. Reppert.

With the increased attention to sanitation and, in particular, the development of pure water supplies and clean waterways, considerable activity has resulted in the formation of various commissions, boards or districts, looking toward the provision of facilities for two or more municipalities acting together. These efforts have come about through the legal difficulty of co-operating without some method of joining responsibilities by organization, and with the knowledge that better development can be had through utilities, such as a water system or sewers, planned to serve a drainage area or district rather than individual towns by political boundaries.

This tendency was early recognized in England through the formation of river boards, such as the Birmingham, Tame and Rea Drainage Board, under whose control is the removal and disposal of sewage of Birmingham and surrounding territory. Such boards in England have been jointly organized under various parliamentary acts for the cleanings of streams to prevent nuisance.

In the United States the tendency was originally toward the formation of commissions organized and empowered by the State to carry out specific work. Among the earlier commissions were the Metropolitan Sewerage Board in Massachusetts, serving Boston and the metropolitan area around, and the Metropolitan Water Board. These two were later consolidated into one board after the major portion of the work had been accomplished. The Water and Sewerage Board has developed largely into an operating organization.

On the other hand, in the West, in Illinois, the formation of sanitary districts received an early start, with the enabling act in 1889 forming the Sanitary District of Chicago, a separate municipal corporation with broader powers than those of the Massachusetts commission, being a separate municipality overlying other municipalities, but with a particular purpose and indefinite life. Further, broader bounding and taxing powers were given than in the East. Other enabling acts have been passed in Illinois and in Indiana. In New Jersey, the formation of the Passaic Valley Sewerage Commission and such joint projects as the Plainfield, North Plainfield and Dunellen Sewerage District, have added to the list.

In the desire to obtain municipal ownership of waterworks in the State of Maine, the water district idea was developed largely through the efforts of Mr. Harvey B. Eaton, an attorney, who has summarized the history and enabling acts very completely in a paper entitled "Maine Water Districts and Appraisals" published in the New England Water Works Association (XIX, 147, 1915).

The Maine water districts resembled the Sanitary District of Chicago, in that they had bonding and taxing powers and were overlying municipalities organized for a specific purpose in the water districts, —that of serving water. A number of districts have been organized in Maine. Elsewhere might be mentioned the Greater Winnipeg Water District and the Metropolitan Water Board of London (England). There are also a number of private water companies supplying groups of towns.

In a report upon the Metropolitan Water and Sewerage Systems made to the Essex Border Utilities Commission, Ontario, Canada (1917), Morris Knowles has covered very broadly the Metropolitan district idea, securing unity of action by (1) annexation, (2) extension of municipal jurisdiction, (3) contracts between municipalities, (4) county administration, (5) private enterprise, (6) metropolitan districts. Various examples are discussed, and the difficulties. The methods in vogue of payment of costs are also discussed, chronologically.

No mention is made in this report of the commissions organized to make engineering reports on metropolitans projects, such as the Metropolitan Sewerage Commission (N. Y. City), Commission on Additional Water Supply (N. Y. Hering-Burr-Freemen), Charles River Dam Commission (Boston) and others. Their field has been a useful one, in most cases paving the way for construction and leading to broader acts for the construction organization.

SCHEMES THAT HAVE BEEN TRIED

In general, it is the purpose of this report to cover largely the districts formed for sewerage or drainage of metropolitan areas, and not the drainage of farm areas. For the purpose of constructing the sewerage system of large metropolitan areas, and the disposal of sewage therefrom, with the increase of population, and the need of more complete methods, various schemes have been tried as outlined. These may be summarized according to the degree of authority given, and appear to fall under three general groups:

1. Commissions or Boards formed by City Councils for the specific purpose of building intercepting sewers largely and practically within the confines of one municipality. These hardly come within the definition of the metropolitan districts serving two or more municipalities, but should be mentioned because of the organization of such Commissions as the Fitchburg Sewer Commission, and the Syracuse Intercepting Sewerage Board, and others.

2. Board or Commissions appointed by elective officers of Cities, County or State, given resources, either limited by specific act or by action of the municipal or Federal bodies governing the municipalities composing the district. Under this classification might be placed such Board as the Metropolitan Water and Sewerage Board, the Passaic Valley Sewerage Commission, the Commission of the District of Columbia and others.

3. The formation of Sanitary Districts which are complete municipalities in themselves, with powers of taxation, with bond issues dependent upon referendum, and with officials appointed by County or State officers. Under this classification come the smaller Sanitary Districts in Illinois, such as those organized at Decatur, Bloomington, the North Shore Sanitary District, and Downers Grove.

4. Sanitary Districts organized as municipalities with complete taxing and bonding powers, without referendum on bonds, with governing officials elected by direct vote of the people residing within the limits of the district. Under this classification comes the Sanitary District of Chicago.

Practically all the districts mentioned and discussed in this report are those lying within the boundaries of one state. The Committee has thought it desirable to call to the attention of those interested the need of some form of organization which will insure co-operation between districts lying in two or more states. With the growth of pollution in streams, and the difficulties in obtaining suitable water supplies such metropolitan difficulties may occur on stream watersheds, both from the water and sewerage standpoint, involving two or more states, as in the case of the Ohio River, for instance, involving Ohio, Kentucky, West Virginia, Pennsylvania, and territory lying in Missouri has to be considered. Such relations under the governmental organization of the United States would appear to require a federal act covering the creation of river or drainage Boards, with powers extending over several states, to coordinate effort and use common policies in matters relating to use of streams for sewage disposal and the taking of water supply therefrom. This would appear to be the next development in a chain of acts which has been gradually formed through the last forty years.

FINANCING

To finance the necessary works, money must be raised. This is usually done by issuing bonds, or by special assessment. Occasionally part of the general taxes is also designated. Operating and maintenance charges, as well as the payments of interest and sinking fund to retire bonds, when issued, are generally met by taxation, or by special assessments and also by rates based upon service.

Where the power to issue bonds is given the amount to be issued is usually fixed, sometimes by definite figures (Fitchburg, Syracuse) but generally in terms of per cent of the valuation of assessed property. In many states this is 5 per cent, an amount fixed by the state constitution. In the Indiana acts, the per cent is fixed at 0.8 of 1 per cent for Indianapolis, and 2 per cent in the general act (1913). In Illinois, the Sanitary District of Chicago has a 3 per cent limit, whereas under the Illinois acts, a per cent limit is set. The maximum rate of interest is also sometimes stated. The maximum rate of interest on bonds is often limited to 5 per cent (Indiana). Although in the case of Indianapolis a 4½ per cent limit was fixed. The retirement of bonds is also provided for 20 year annual installments being common (Illinois, Indiana). In the Essex Border Utilities Act the limit was set at 30 years, whereas at Indianapolis 50 years was allowed.

In the older districts bonds may be issued without referendum for the corporate purpose. In the districts formed more recently, many acts require a referendum on the bonds, as a whole. Where the act specifically limits the amount in dollars, as a rule the act is the result of public agitation demanding relief.

In the case of the Illinois and Indiana districts special assessment has not been used to meet construction in Metropolitan organizations. In the Passaic Valley, however, the cost of construction was assessed or apportioned among the various constituent municipalities roughly in proportion to the service rendered. In the Vancouver sewerage act 30 per cent of the construction cost is to be assessed upon the municipalities in proportion to their land valuations, and the remaining 70 per cent in proportion to the valuation upon lands benefited. But in determining the division of operating costs, assessment is frequently made against the individual municipalities in the district, which in turn is distributed by taxes or service charges (Boston Metropolitan District, Passaic Valley, Miami Conservancy). In Illinois and Indiana, tax levies are made through the usual machinery, to raise the monies to pay interest, operating and maintenance expense, and provide a sinking fund to retire bonds.

In Indiana, for Indianapolis, a levy of two cents on the $100 was allowed, plus a levy for sinking fund and interest. The general Indiana Act provides for 0.25 of 1 per cent.

In Illinois, the Sanitary District has a taxing power of 2/3 of 1 per cent of the assessed valuation. Owing to the scaling of the amount by the County Clerk, a recent amendment has placed a minimum rate of 1.2 mills on the dollar. The general Illinois acts provide in one case for a rate not to exceed ½ of 1 per cent, and in the other for ½ of 1 per cent, although the latter may be doubled by a referendum vote.

In the Miami Conservancy District a levy of 0.3 mill on the dollar is provided for preliminary expenses.

The size of the governing board varies widely, from a minimum of three (Illinois general, 1917) to a maximum of 13 (New Orleans) in the U. S. and 17 (Essex Border) in Canada. Some acts provide for service without pay, others provide pay as high as $7,500 per year.

The limits set on the powers of the board vary. Some acts are very explicit on the terms of advertising contracts, etc., others are not. Ten (10) days is a common limit. Some prescribe thirty-one (31) days. The limit of expenditure without advertising is occasionally fixed, $500.00 being a common figure.

In general, the acts appear to have been effective in providing machinery for necessary work. Occasionally, where a referendum is required, the project has failed by lack of votes to authorize bonds (Bloomington and Normal) or has been delayed by failure to seek authorization of bonds. The limits set by per cents of valuation in some cases have proved inadequate, and in future acts should be chosen with greater care, to provide necessary funds, both by taxation and by bond issue.

NEWS OF THE SOCIETIES

CALENDAR

Jan. 13 — ENGINEERS' CLUB OF SEATTLE. Seattle, Wash. Secretary, Lyman T. Banks, 916 L. C. Smith Bldg., Seattle.

Jan. 14—LOUISIANA ENGINEERING SOCIETY. New Orleans, La.

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland Ohio.

Jan. 17-18—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chicago, Ill.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 18—ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS. Annual meeting. Secretary, Miss C. B. Adams, 3817 Olive St., St. Louis.

Jan. 18—SIOUX CITY A. A. E. Joint meeting with the Iowa Engineering Society convention. Sioux City, Ia.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERING. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28—ARKANSAS CHAPTER, A. A. E. Little oRck, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' building, New York City.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

GOOD ROADS CONGRESS

The growing demand for wider and roads and stronger bridges has awekened the officers and directors of the American Road Builders' Association to the need for action and the program committee has provided for an exhaustive discussion of the subject at the Twelfth American Good Roads Congress and Thirteenth National Good Roads Show to held in Chicago, Janueary 16 to 20, next.

The elimination of grade crossings will be one of the phases considered. Out of 12,000 persons killed on the highways of the country last year, 7,000 were struck down at grade crossings.

An investigation conducted recently by the Maryland State Roads Commission demonstrated that most highway accidents occur on long stretches of road instead of at the curves and are due to speeding or reckless driving, rater than skidding. Investigation has shown also that one motorist in every three is careless at grade tracks at reckless speed and without taking due notice of approaching trains.

The Pennsylvania and Southern Pacific railroads, especially, have been heavy sufferers from grade crossing accidents. On the Southern Pacific lines alone during tse past three years 1909 motor cars and trucks were wrecked at grade crossings. In 490 cases, or more than 20 per cent, the mitorists deliberately ran into the trains. In 122 instances autos plunged throug the crossing gates. Nine crossing fiagmen were struck down.

In 970 cases in which motorists ran in front of the trains 136 persons were killed and 405 were injured. In 490 cases motor cars stalled on the crossing and were demolished. Forty-three cars actually colided with the danger signals.

A total of $4,500,000 was paid out in death claims by American insurance companies for the 12,000 persons killed on the highways last year. In addition to the fatalities there were 1,500,000 non-fatal injuries.

At the good road congress many subjects of importance to highway users will be discussed, including the strengthening of bridges to carry the ever increasing truck loads and a more equitable distribution of taxation for the construction and maintenance of highways. Last year Federal, state and municipal taxes on motor cehicles reached the staggering sum of $316,-720,000—equivalent to $34 per car. Governors of states, county commissioners and mayors of cities throughout the country are being asked to appoint delegates to the congress.

The American Road Builders Association has issued very complete data for the infermation of exhibitors in the Good Roads Show, fully covering the packing, marking, shipping evpressing, trucking, erecting, installation, arrangement of machinery and other exhibits, furniture and decorations for booths, lighting insurance, signs, etc.

Henry W. Wilson has been elected Vice-President and General Manager of Willite-Road Construction Co., of Penn. Hhis company awns the control of the N. J. Willite Paving Co. and the Southern Willite-Paving Co. Large yardages of Willite pavement have been constructed in New Jersey and Pennsylvania this past season and additional work is rapidly being booked throughout the same territory and also in Maryland, Virginia and North Carolina. These companies have no connection with the Willite-Road Co of Mich.

Charles F. Bauer has been elected Vice-President of N. J. Willite-Paving Co. Office will be opened on the completion of the building of the Trust Co. of New Jersey at Bergen and Sip Avenue, Jersey City.

Major J. L. Lee, recently of the Construction Division, Q. M. C. U. S. Army, has been appointed District Manager of Willite Road Construction Co. of Pa. with offices at 611 Brown Bros. Bldg., 4th and Chesnut St. Phila. Pa

ASSOCIATED GENERAL CONTRACTORS

At the Cleveland Convention, Jan. 17, 18 and 19 there will be a Highway Divisional Meeting, Jan. 18, for which the chairman, Stanley D. Moore, Wateill Ia. requests advance notices of subjects proposed for discussion.

The meeting will be divided into two sessions. The morning session will be for introduction and discussion The afternoon session will be devoted to action and resolutions.

The following subjects have already been proposed for discussion; more are invited

1. Freight rates on empty cement sacks.
2. Elimination of tax free bonds and securities.
3. Cement Trade Practice.
4. New lessons learned this year.
5. Classification of Excavation.
6. Free and overhaul limits.
7. Price revision of quantity changes.
8. Responsibility, penalties, and remuneration for delays.
9. Equipment shortcomings and innovations.
10. Provisions for inspection at source.
11. Separation of unit price operations.
12. Allocation of overhead on force account work.

New Catalogs of Interest to City and County Engineers, Superintendents of Water Works, Superintendents of Streets, Contractors and All Engaged in Public Works

If you want any of these Catalogs, write the number on a postal, sign your name and address plainly, and mail it to PUBLIC WORKS, 243 W. 39th St., New York. The Catalogs will be sent to you promptly without charge or obligation.

COLUMBIAN TRUCK EQIUPMENT

245. Columbian Steel Tank Co., 1519 W. South St., Kansas City, Mo. Data sheet No. 59, illustrations of Columbian dump bodies, hand hoists and motor-motive hoists, with descriptions of special features of 5 styles of dump bodies.

FORDSON TRACTORS SPECIALTIES

246. Wehr Company, 533 30th St., Milwaukee, Wis. Leaflet descriptive of the Wehr road grader-cleaner, a road making machine intended for county road patrol work.

PROPER USE OF CEMENT

247. Lehigh Portland Cement Co., Chicago. A vest pocket booklet on the fundamental principles of concrete handling with practical suggestions, directions and sketches concerning materials, mixing, placing, proportion of mixtures and cautions.

SAND

248. Lehigh Portland Cement Co., Chicago. A vest pocket booklet on the importance of sand in the making of concrete and method of testing. Describes the respective properties of coarse and fine sand and the necessity of having clean sand and explains methods and apparatus for making field tests of sand for organic impurities as adopted by many laboratories, engineers and contractors to determine the feasibility of sand for use in concrete.

AIR LIFT PUMPING SYSTEMS

249. Sullivan Machinery Co., Chicago, Ill. 6 x 9, 40 pages, description of methods and apparatus for deep well pumping with many illustrations of installations, diagrams of principal details and convenient tables of required data.

DISPLACEMENT PUMPS

250. Sullivan Machinery Co., Chicago, Ill. Leaflet describing a displacement pump for elevating acids by compressed air in which among other advantages the liquid pumped does not come in contact with any moving part, there is no precipitation or emulisification of the acids being pumped and a wide range of materials, capacity and pressure is afforded.

SULLIVAN ROTATORS

251. Sullivan Machinery Co., Chicago. 6 x 9 in., 32 pages, catalog of all round rock drilling machines or improved type of hammer drill used for block holing, shaft sinking, drifting, stoping, and light tunneling in hard and soft rock, quarries, road grading, sewer trenches, and open cutwork. Complete details illustrations and descriptions and examples of use of machines, weighing 29 to 40 pounds.

KOEHRING PAVERS

260. Koehring Co., Milwaukee, Wis., 7½ x 12½ inches, 16 pages, illustrated, stiff covers. Describes machine for which exceptional speed and durability are claimed. Illustrates five-action mixing principle, measurement of water, and accurate timing, and describes principal features of construuction and operation.

STANDARD FUEL OIL ENGINES

261. The Hadfield-Penfield Steel Co., Bucyrus, Ohio, two 9 x 11 inch catalogs describing and illustrating their Diesel Type Horizontal and Vertical Standard Fuel Oil Engines. The engines are built on the two cycle principle with a cross head which also serves as a pumping piston for furnishing air to clean out and fill the main working cylinder.

The Horizontal Engine is built in three cylinders in three sizes—50, 75 and 100 B.H.P. The latter two sizes being built as Twin Units giving 150 and 200 B.H.P. The Vertical Engine is built in two cylinder sizes—50 and 125 B.H.P. per cylinder and two to six cylinder units.

YUBA RODEBILDER

262. Yuba Mfg. Co., 438 California St., San Francisco, Cal., folder describing tractor with caterpillar tread and single front wheel that developes a 6,000 pound drawbar pull with 40 h.p. pulley rating.

CENTRIFUGAL FIRE PUMPS

263. Dayton-Dowd Co., Quincy, Ill. Lists and illustrates gasoline and turbine driven centrifugal fire pumps with capacities up to 1,500 r.p.m. under a pressure of 100 pounds. Gives photographs of installation and tests of equipment.

TWO-STAGE AIR COMPRESSORS

264. Curtis Pneumatic Machinery Co., St. Louis, Mo. Leaflet describing two-stage compressors with copper intercooler and special fly wheel that is designed in one size only but can be operated at different speeds and thus secure two corresponding capacities.

SEWAGE TREATMENT

265. Dorr Co., engineers, 101 Park Ave., New York City. Bulletin illustrating use of Dorrco screens and method of treatments of sewage and waste waters from municipalities, industrial works and others.

AVERY GOOD ROADS NEWS

266. Avery Co., Peoria, Ill. A periodical issued "in order to spread the propoganda of correct construction and maintenance of dirt roads. Emphasizes the use of the Avery Road-Razer.

CONCRETE EQUIPMENT

267. Miles Mfg. Co., Jackson, Mich. 7 x 10-inch, 60 pages, descriptions and illustrations of simplex continuous concrete mixers and of presses for making concrete and cement block and bricks.

CONCRETE AND MORTAR MACHINES

268. Republic Iron Works, Tecumseh, Mich. Bulletins Republic 10, Monarch, and Republic 6, illustrating sack size concrete and mortar mixer, cement block machines, and super-6 general utility concrete mixer, mounted on wheels.

NORTHERN CRANE

269. Northern Engineering Works, Detroit, Mich. Catalog 28, 6 x 9 inches, 32 pages, listing and describing electric travelling cranes, bridge and gantry cranes, hand power cranes, and all types of pillar and jib cranes, derricks, electric hoists, overhead tracks, air hoists, trolley, air jacks, turntables, transfer tables, and miscellaneous electric pneumatic hand power equipment.

REINFORCED CONCRETE PAVING

270. Thomas Steel Reinforcement Co., 1112 Majestic Bldg., Detroit, Mich. 9 x 6-inch 48-page pamphlet, illustrating construction of pavement with little Hercules reinforcement bar stool and anchored protection for expansion joints.

POINTERS TO PROFIT

271. Acme Motor Truck Co., Cadillac, Mich. 1921 edition, 6½x10 in., 40-page catalog, of 1-ton, 1½-ton, 2½-ton, 3½-ton, and 5-ton chassis and body equipment, including 1921 specifications for Acme model AC 2½-ton special truck, designed to meet the speed and power requirements, for city fire departments, long distance hauling, road building and other special work.

MEMONINEE MOTOR TRUCKS

272. Menominee Motor Truck Co., Clintonville, Wis. General specifications for 1-ton, 1½-ton, and 2-ton trucks of high quality.

New Catalogs of Interest to City and County Engineers, Superintendents of Water Works, Superintendents of Streets, Contractors and All Engaged in Public Works

If you want any of these Catalogs, write the number on a postal, sign your name and address plainly, and mail it to PUBLIC WORKS, 243 W. 39th St., New York. The Catalogs will be sent to you promptly without charge or obligation.

TEXACO SHEET ASPHALT

273. Texas Company, 17 Battery Place, New York City. Small booklet, describing construction of Texaco sheet asphalt pavement, with different kinds of foundations and an open or closed binder course, together with a wearing surface with instructions how to prepare and place the binder and wearing surface, sections of pavement and illustrations of operations and finished work.

CONCRETE HIGHWAY BRIDGES

274. Lehigh Portland Cement Co., Chicago. 6 x 9 in., 13 pages, paper covered, illustrations of smaller types of concrete highway bridges and culverts, discussing the advantages of concrete, principal of construction. Shows many half tones of attractive structurts and gives tables of bearing power of soil and of quantities required by the Wisconsin Highway Commission for bridges up to 24-foot spans. Typical workings drawings of 14-foot spans and of 3 x 4-foot box culverts.

BULK CEMENT

275. Lehigh Portland Cement Co., Chicago. 6 x 9 in., 10 pages, discussing advantages and giving examples of bulk shipment and describing methods of unloading, handling and measuring cement in bulk.

HOYNESITE EXPLOSIVES

276. Hoynesite Explosives Co., general office, 316 National Building, Cleveland. Booklet describing the advantages claimed for Hoynesite explosive used as blast to throw rock, in pellet form as coal powder, as oil well powder, and as special powders made up to requirements.

CRESCENT SEWER PIPE MOULD

277. Barber & Long Mfg. Co., Kendallville, Ind. Bulletin of sectional all-steel bell end forms both for sewer pipes and culvert pipes of any length, diameter and thickness required.

BULL-DOG BATCH MIXERS

278. Barber & Lang Mfg. Co., Kendallville, Ind. Bulletin 16, illustrating and describing steam driven side loader mixers and gasoline driven power side loader mixer all on trucks with prices and specifications.

TOP-STEWART TRACTORS

279. Top-Stewart Tractor Co., Clintonville, Wis. 7½ x 6¼ in., 32 pages illustrated, bulletin of machine with special traction shoes, with illustrations of its use for building and cleaning irrigation ditches, and road ditches and for hauling trailers, scarifiers, wheel scrapers and gravel wagons in road patrol work. Specifications, pictures and ilustrations of operations, and testimonials.

STEEL JAIL CELLS

280. E. T. Barnum Iron Works, Detroit. Jail Cell catalog 458. 1½ x 8½, 32 pages, illustrated, steel cells and jail fittings and equipment, with several plans for small jails.

ENGBERGS VERTICAL ENGINE

281. Engbergs Electric & Mechanical Works, St. Joseph, Mich. 8½ x 11 inches, 36 pages, illustrated, heavy paper covers, illustrations and descriptions of 1 to 100-h. p. engines that have been furnished in large numbers to municipalities and industrial organizations and for operating compressors, generating sets, pumps, sand and mixers, and for general power purposes.

DIRECT CURRENT GENERATING SETS

282. Engbergs Electric & Mechanical Works, St. Joseph, Mich., 8½ x 11-inch, 32 page, illustrated, heavy embossed paper cover, catalog 103 of Direct Current Generating Sets of 1 to 50 kw.

CONVEYORS

283. Chicago Automatic Conveyor Co., Lumber Exchange Bldg., Chicago. Illustrated bulletin of portable, wheeled, extended, fixed and semi-portable belt and bucket conveyors for handling and transporting materials and loading and unloading cars and trucks.

NORTHERN ROTARY PUMP

284. Northern Fire Apparatus Co., Minneapolis, Minn. Leaflet describing chief types of pumps with capacities ranging from 26 to 1,000 gallons per minute at pressures of 50 to 300 lbs., furnished for electric, steam or oil drive, belt gear or straight line flexible pumping connection.

PUMPING MACHINERY

285. Advance Pump & Compressor Co., Battle Creek, Mich. Bulletin 201, 6 x 9 inches, illustrated. Bulletins 201-220 inclusive in adjustable stiff paper covers, describing duplex steam pumps, power pumps, and centrifugal pumps designed with open impellers for a wide range of service.

WILLITE ARMOUR PLATE ROADS

286. Willite Road Construction Company of New York, 51 Chambers St., New York City. Booklet describing Willite process for paving roads with asphaltic binder, containing metallic sulphite, designed to preclude the necessity of special draining of mineral aggregate to insure stability. Illustrated by views and descriptions of roads under construction.

DUFF GENUINE BARRETT JACKS

287. Duff Mfg. Co., Pittsburgh. Folder 803, illustrates and lists principal types of automatic lowering jacks, ball bearing screw jacks, traversing telescopes, screw jacks, motor truck jacks and pipe forcing jacks.

DUFF BANTAM TRENCH BRACES

288. H. W. Clark Co., Mattoon, Ill., Folder describing types of braces with screw adjustments to lengths of from 16 to 60 inches, also Duff Screw Fittings for timber bracing.

WATER WORKS EQUIPMENT MATERIAL AND SUPPLIES

289. H. W. Clarke Co., Mattoon, Ill. Catalog 20, adjustable board covers with fastenings for Bulletins A and AA, illustrating various types and sizes of cast iron meter boxes, forms and fittings for concrete and masonry meter boxes. The whole Catalog 20 will contain 9 bulletins, of which the remaining 7 will be sent on application, as published.

KOEHRING COMPANY, MILWAUKEE, WIS.

290. Leaflet describing construction 18-foot pavement at rate of 536.8 linear feet in 10 hours, using a Koehring Aggregate Bin, No. 21 and mixer. With a total force of 53 men.

QUALITY TANK BODIES AND HOISTS

291. Heil Company, Milwaukee, Wis. Catalogs 120 and 120A, bound in adjustable heavy paper covers, illustrate and describe combination dump bodies with extended platforms, asphalt bodies, garbage bodies, lumber and coal bodies, high lift dumping equipment, gravity tilting dumps and hydrohoists.

VALVES

291. Atlas Valve Co., 282 South St., Newark, N. J., Catalog No. 21, 3½ x 6¼ inches, 20 pages, descriptions and prices of Atlas, Ideal and Victory Reducing Valves, Pump Governors, Pressure Regulators, Hot Water Tank Regulators, Control Valves and Damper Regulators. Vacuum, float and balance valves and fittings.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 NEW YORK, JANUARY 14, 1922 No. 2

New London Turnpike

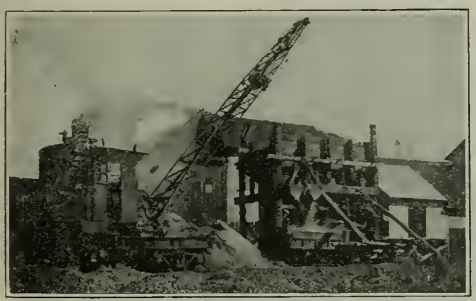
Building thirty-two miles of 18-foot concrete highway in one season with 700 men and four paving machines. Aggregate purchased, produced by contractor, shipped by rail and truck, stored at central and at intermediate points, handled at storage by three locomotive cranes at a cost of only 9.22 cents per ton and distributed by industrial track and trucks.

The Highway Commission of the State of Connecticut awarded to C. W. Blakeslee & Sons, New Haven, at unit prices, the contract for the construction of the 33½ miles of the state highway known as the New London Turnpike, and extending from Glastonbury, about eight miles south of Hartford, through Marlborough, Colchester and Chesterfield to a point about four miles north of New London.

The road, which is within 150 miles of New York, follows the alignment of an old earth road with very little improvement or hard surface that wound around the contours of a hilly and very sparsely settled agricultural district and served only for limited local access to and from the nearest improved roads. It had many grades, some of them excessive, and numerous sharp turns, both of which were considerably reduced in the new line, which has a maximum grade of 11 per cent. and in the first few miles north of Glastonbury surmounts a hill 600 or 700 feet high involving heavy cuts and high embankments, some of them of as much as 20 feet.

The road was built with Federal aid and the hearty co-operation of the Federal and chief engineers in testing and examining all materials used in its construction and in the determination of grade and the design of foundation and subgrade insured unusual excellence of design and construction, the latter being effected by a large organization supplied with abundance of high-class equipment and directed by superintendents of proven ability and experience.

The road has a concrete surface 18 feet wide, 8½ inches thick in the center and 6 inches thick at the edges, without reinforcement and with expansion joints 35 feet apart. On each side is a shoulder 5 feet wide. There are eight beam and slab bridges of 9 to 25 feet span and many pipe culverts with concrete end walls. The local drainage is cared



CRANE AT COLCHESTER YARD LOADING DIRECTLY INTO A TRUCK

STONE BIN OF THIRTY-FIVE YARDS CAPACITY AT WESTCHESTER

COLCHESTER 60-YARD SAND AND STONE BIN AND INCLINED TRESTLE APPROACH

for in longitudinal rubble pipe drains adjacent to the shoulders, connected when necessary by transverse pipe drains underneath the roadway.

The principal quantities involved include about 111,530 yards of earth excavation, 21,000 yards of rock excavation, and 36,000 yards of borrow pit excavatioin for embankment. The pavements, bridges and culverts required about 67,000 yards of concrete for which it was necessary to provide 60,000 yards of stone and 30,000 yards of sand; the cement, amounting to about 375,000 bags, was provided by the state.

As there was very little traffic over the original road, no difficulty was experienced in diverting it in nearly all cases, so that the new construction was carried on practically regardless of traffic, except in two places where short sections of the road were necessarily left over until next season and will be constructed in successive longitudinal halves to maintain the traffic between the adjacent long sections of finished roadway already in service. Construction was commenced in April, 1921, and on November 15, when the concreting was suspended 32 miles of the pavement had been completed, leaving only two short strips of about ¾ mile each to be concreted next spring to finish the job. After the cessation of the concreting, work was continued until late in the season, chiefly consisting in completing the shoulders, finishing a small portion of difficult grade and in temporarily surfacing the subgrade of the incompleted mile and a half of road with quarry dust to enable it to bear the winter traffic and allow the road to be in service. It is possible that, considering the unusually warm November weather, the concreting might have been completed this season if the contractor had insisted on it, and had been willing to assume the added difficulty and expense of concreting in cold weather, provided such work had met the approval of the engineer; but it was deemed by all to be more satisfactory to stop the concrete practically at the beginning of frosty weather, leaving a small portion to be done early next season.

EXCAVATION

Excavation was carried on simultaneously at several different points by four Marion revolving and Erie steam shovels and one gasoline operated Pawling & Harnischfeger excavating machine, equipped with a ½-yard clamshell bucket. The rock was drilled by means of 16 Ingersoll-Rand tripod and 6 jack hammer drills operated by 4 portable boilers and by three portable Imperial type air compressors.

The excavated material varied from sand to loam and cobbly gravel and rock. For the rock excavation there were 7 drilling outfits all equipped with Ingersoll-Rand apparatus. Three of them used air compressors, each requiring one operator and supplying one or two jackhammer drills. The other four outfits each had a 5 h. p. locomotive boiler and four tripod drills, which were operated on thorough cuts. The deepest rock cut was about 20 feet. In one place the new alignment involved heavy rock cutting for the excavation of about 300 yards of irregular seamy-granite that was difficult to handle because the drills would frequently strike a crack or seam in which they were lost, necessitating the starting of a new hole.

The explosives used were chiefly 40 to 60 per cent. regular gelatine nitroglycerine in one pound sticks fired by a battery. Some TNT purchased from the War Department was used in drill holes, but it was found to work more satisfactorily on mud caps. The dynamite was stored in three dugout magazines, which were replenished about once in two months.

None of the rock excavated was suitable for concrete work and all of it was spoiled for use in embankment. The steam shovels were served with about forty 5-ton trucks mostly of the Mack and Pierce Arrow types, and by about seventy-five 2-horse bottom dump wagons.

In the earth cuts the steam shovels were followed by wheeled scrapers, of which about twenty were provided. The smaller ones were drawn by horses, but the larger ones, of the Champion type with 10-foot blades were hauled by a Cletrac tractor, finishing the subgrade advantageously about 400 feet minimum, in advance of the concrete mixer.

An attempt was made to use a sub-grading machine, operated on the steel side forms, but this was not satisfactory on account of large quantity cobble stones it encountered that caused the machine to jump and operate irregularly.

Where the new road was built over previous roads that had stone or macadam surfaces, the latter were thoroughly loosened with a scarifier attached to a steam roller. All of the subgrade was thoroughly rolled to acurate cross section and elevation determined by a level and straight edge with which it was carefully checked. If the grade was found low, more material was added and rolled to bring it to the exact position, the engineers being very particular that the subgrade should be perfect so that the concrete would be uniformly of the thickness required. There were installed five ten-ton Buffalo rollers, each with a scarifier, and operated from 400 to 600 feet in advance of the mixer.

Wherever the subgrade was wet, and in swampy places, the excavation was made 15 inches below regular subgrade elevation and there was built a foundation of Telford stones 12 inches thick covered with 2 inches of crushed rock and a layer of sand thoroughly rolled to subgrade.

All of the Telford excavations and some of the ditches for rubble drains and excavations for culverts, were made with steam shovels, but where these were not available, the work was done by hand. The rubble drains, 36 inches below grade, consisted of a bed of ¾-inch crushed stone on which

were laid 6-inch tile pipes with open joints covered with larger stones laid carefully up to within 6 inches of the subgrade, and then covered with brush or straw mattress and crushed stone. There were in all about 30,000 square yards of Telford, 20,000 lin. feet of rubble drain and 6,600 lin. feet of cross culverts. The culverts were made with pipe up to 30 inches in diameter. The ends of all culverts were enclosed in concrcete or masonry headwalls, for which and for the bridges there was used a portable 2-bag Chain Belt mixer.

The 33½ miles of road were divided into four equidistant contracts, No. 1 extending from Glastonbury, where there was a freight station, about 8 miles south of Hartford, to Marlborough. The second section extended from Marlborough, passed through Westchester where another freight station was established, and extended south to Colchester, where there was established a freight yard. Section 3 extended from Colchester, south to Salem. Section 4 extended from Salem to a point four miles from New London, with a freight station established near that end of the section.

All of the aggregate for the first four miles at the north end of the road, in contract one, was delivered by trolley cars to the freight station at Glastonbury, where there was a cement storage shed of 12 yards capacity, supplied by railroad cars running over the trolley line from Hartford.

The contractor established four railroad freight yards for the receipt, storage and transfer of supplies and equipment, all of which received broken stone, cement, coal and machinery and were served by two Brownhoist 15-ton locomotive cranes, one Browning Hoist crane, and one Pawling & Harnischfeger locomotive gasoline crane.

At the Westchester yards the broken stone was received in railroad cars and unloaded into stockpiles by the locomotive crane, which also towed the loading hopper alongside the stockpiles. At Glastonbury the stone was delivered in automobile trucks that were run up a ramp built on a timber trestle and carried over the loading hoppers into which they dumped directly. At Glastonbury the broken stone was received in side-dump standard gage cars, run over the trolley line and up an inclined trestle to a height of about 20 feet above the ground, where they were dumped to make a large storage pile in which 1,200 to 1,500 yards of stone were accumulated before operations were commenced; but the stone was shifted from the storage pile to the 8-yard loading hoppers by a locomotive crane that was kept constantly busy although not operated to its full capacity. At both the Westchester and Glastonbury yards the locomotive cranes were more than competent to handle all the stone to and from the storage piles and loading hoppers, and to handle the coal and perform other services such as shifting cars, unloading plants and serving as general locomotive derricks.

The first locomotive crane was installed at the commencement of operations in April, 1920, another was installed in May, and a third in July, 1921, after which one was removed to another job, leaving two Brownhoists and one steam crane on the road construction. For this work the Brownhoists were equipped with ¾-yard and 1-yard buckets and unloaded a 45-ton car in an average of about one hour, thus having a capacity for eight cars per day. In practice this number was reduced to about five cars per day because that number sufficed for the amount of construction in progress and because the switching facilities were limited and considerable time was lost by the Brownhoist in handling the full and empty cars. As about one-third of the broken stone was first unloaded into storage piles and afterwards transferred, reclaimed and placed in the loading hoppers, the average duty of 225 tons a day for each of the Brownhoists was really equivalent to 300 tons per 8-hour day, which was considered very satisfactory. The contractor estimates that the life of the locomotive cranes is at lease fifteen years and perhaps twenty years.

During the working season of 192 working days between April 15 and December 1, each locomotive crane consumed about ⅝ ton of coal per day, making a total of 120 tons at $9.00 per ton. The operation of the crane required one engine man at $9.00 a day and one fireman at $4.00 a day, making the total labor cost for the year $2,496. The interest on the investment at 7 per cent is $353.27, depreciation on the cost price of $9,460 divided by 16 years is $630.07, repairs and maintenance, including cables, $750, making the total operating cost for one year $5,309.84.

The service performed by the crane, namely unloading five cars per day for 192 days is 950 cars or 42,200 tons, plus 20,400 tons handled from storage to bin, equals 57,600 tons at a cost of $0.0922 per ton.

It is estimated that the cost of the same work done by hand would be $.50 per ton or $28,800, thus showing a saving of $23,490.16 made by each locomotive crane, equal to $46,980.32 for the two Brownhoists applied continually on the road work or a saving of 40.78 cents per ton on the material handled.

CONCRETING CULVERT WITH PORTABLE MIXER

DIFFICULT ROCK EXCAVATION IN DARK HOLLOW

CLETRACTOR HAULING ROAD MACHINE OVER MACADAM ROAD

Up-to-date Concrete Road Construction

Brief reports from recent work in different states.

Contractors for concrete road construction throughout the United States have, during the past few weeks, sent to Public Works various data regarding the magnitude and character of the work they were engaged on, the requirements, conditions, difficulties encountered, equipment installed, methods of construction, and efficiency and rapidity attained. Some of these data, indicating special features or unusual results, will be presented in separate descriptive articles; others that may not present any unusually important or novel features but are nevertheless valuable as representative of current practice or standard operations have been selected as describing satisfactory results and reliable efficiency. Some of them are here summarized.

SAXONBURG ROAD

This road is located in West Deer township, Allegheny county, Pennsylvania, and is 7,400 feet long with 600 feet of a maximum grade of 7.25 percent and 390 feet of curve with 350 foot maximum radius.

The road is a new location through rolling country in a loam soil, and involves 27,750 cubic yards of excavation without rock work, culverts or bridges. The contract was awarded to the McCrady Bros. Co., Braddock, Pa. Work was awarded August 26, 1921, and it is expected will be completed on June 15, 1922. The total contract price is $37,258.50 or $5.04 per linear foot of paving. The average force consists of 50 men working 10 hours per day and receiving thirty cents per hour for laborers and one dollar per hour for mechanics.

Broken stone and sand are delivered by rail to a central storage plant, where it is handled by Galion loaders, stored in bins and delivered in measuring boxes, hauled by five motor trucks. The concrete is surfaced with a Lakewood finisher, and protected during curing by tarpaulins, straw and moistened earth. The best daily record is 480 linear feet.

LINCOLN HIGHWAY

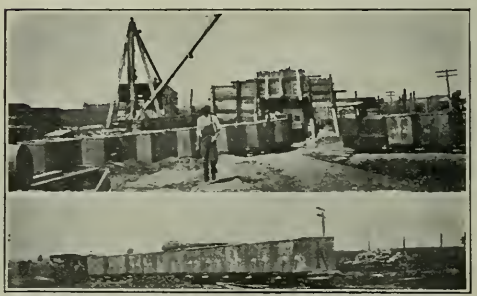
Federal Aid Project No. 18 in Clinton County, Iowa, is a 17.5 mile stretch of the Lincoln Highway paved with reinforced concrete 18 feet wide, 8 inches thick at the center and 7 inches thick at the sides, under the direction of P. W. Shive, resident engineer. The location is an old alignment with 6 percent maximum grade and two right angle curves. There is about 80,000 yards of dry earth excavation in level and hilly country and with a maximum haul of 7,000 feet, made with elevated graders, wheelers, slips and Fresno scrapers.

Aggregate was received on railroad cars and unloaded to stock piles with a derrick and clam shell. It is handled to the concrete paver by two separate outfits, one consisting of automobile trucks loaded from a hopper bin that served eight miles of the road and the other an industrial railway outfit that served the remaining 9½ miles. Each of the two sections in which the work was executed was equiped with a 21-E Koehring mixer operated by a steam engine. The greatest amount of pavement laid in one 8-hour shift was 650 linear feet. The contract was awarded May 1st and completed October 1st and was considered by the contractor, the Koss Construction Co., Des Moines, Iowa, to be extraordinary only in the fact that it was the largest single stretch of concrete contract awarded up to date.

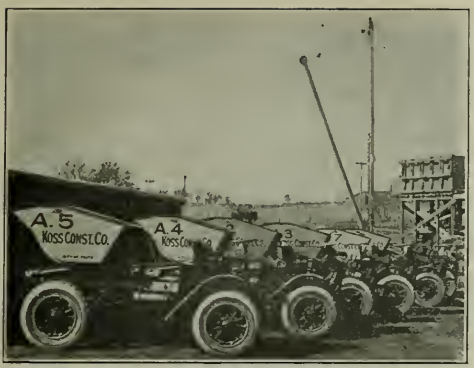
On the section operated by the industrial track service the Koppel tracks ran alongside the cement storage shed and were connected to the loading track on both ends of the storage pile through which the track passed in a wooden tunnel with vertical transverse wooden bulkheads at both ends to retain the aggregate that was unloaded from the railroad cars and piled over the tunnel by a derrick and clamshell bucket. The Koppel batch boxes were loaded in pairs on flat cars, from 7 to 11 of which were drawn in trains hauled by Plymouth gasoline locomotives, which passed entirely through the tunnel and could be switched from the main track.

On the other section of the road tilting hoppers carried in pairs on a fleet of auto-car trucks delivered directly to the loading skips of the paver, against which the truck backed up until it engaged a buffer, dumped the bucket, advanced while the mixer was being charged and when the skip was returned to position on the ground backed up again and discharged the second of the pair of buckets it carried.

DUMPING BATCH BOX INTO PAVER SKIP



UNLOADING DERRICK SERVING STOCK PILE OVER LOADING TUNNEL—GASOLENE LOCOMOTIVE HAULING TRAIN OF INDUSTRIAL CARS WITH PAIRS OF BATCH BOXES



FLEET OF TRUCKS HAULING AGGREGATE TO PAVER, LINCOLN HIGHWAY

OHIO HIGHWAYS

The Republic Asphalt Paving Co., Dayton, Ohio, was the contractor for 3 miles of 16-foot concrete pavement 8 inches thick in Auglaise county, Ohio. The work was executed in six weeks, materials being hauled to the Koehring paver in trucks, each of which carried four batches and dumped directly into the skip of the machine.

In Shelby county, adjacent to Auglaise county, the same contractor built one mile of 16-foot, 8-inch concrete pavement in 12 days using the same method. The same paving machine was also used by the contractor with satisfactory results in Wilmington, Ohio, and was considered to be preferable for this work to the number 11 Koehring machine that required nearly as much fuel and oil but had only about half the capacity. The best record for one 10-hour shift was 712 linear feet of 16-foot roadway 8 inches thick, paved with 1:1½:3 concrete.

IN CHAMPAIGN COUNTY, ILL.

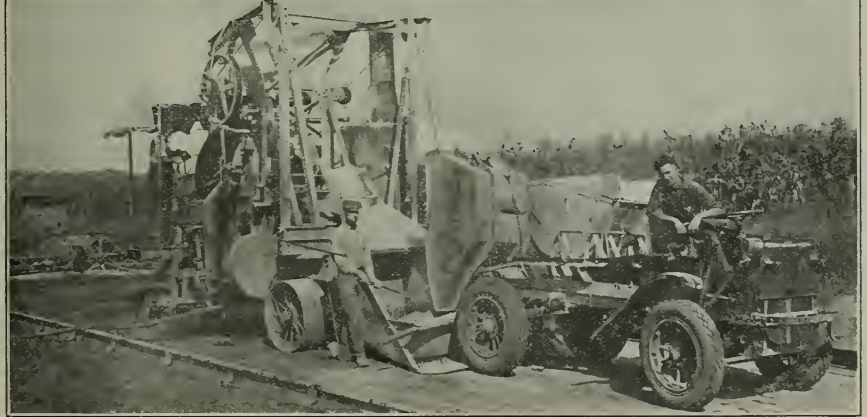
The contract for the 12½ miles of 18-foot concrete highway, 7-inches thick in Champaign County was awarded for $270,000, to the Barns & Verhey Construction Co., St. Joseph, Ill., who commenced operations March 9th, 1921, and expect to complete them by July 1, 1922. The work consists of the improvement of an old road, with grades reduced to one per cent, requiring 40,000 yards of excavation with a maximum haul of 500 feet.

The aggregate was unloaded by a crane, that placed it in stock piles and delivered to automobile trucks by which it was taken to the 21-E mixer that advanced at a maximum rate of 660 linear feet in eight hours with a total force of about 30 men inclusive of those employed in grading, which was done by the sub-contractor. Water was delivered to the job by the contractor with C. H. & E. pumps, and the fresh concrete was protected by canvas until after initial set.

LACKAWANNA TRAIL

The contract for 6½ miles of concrete highway pavement on the Lackawanna Trail between Nickelson and Forster, Pennsylvania in the State Highway System was awarded for $420,000 to the Awixa Corp., Islip, N. Y., which commenced operations June 16, 1921 and expect to complete the work within one year from that date. The road, 20-feet wide and from 6 to 8 inches in thickness, is constructed on a new alignment in hilly country with maximum grade with 3½ percent and curves of 6 degrees. It involves the excavation of about 25,000 yards of earth and 25,000 yards of rock, a maximum haul of about ½ mile. The total amount of concrete required is about 35,000 yards, besides 1,500 yards of culverts. Aggregate is received by rail and unloaded by a crane and immediately delivered to the mixer without intermediate storage. It is taken in automobile trucks to the 21-A Koehring paving machine and to the Koehring Dandy Mixer for culvert work. The maximum progress has been so far 1,096 square yards in eight hours and the total force of 135 men with a weekly payroll of about $4,000.

Grading was done with Bucyrus steam shovels, served with four 4-yard trucks and water was pumped by the contractor's C. H. & E. pumps delivering through a maximum of 4 miles of pipe.



LOADING AGGREGATE DIRECTLY FROM DUMP TRUCK TO PAVER SKIP, LINCOLN HIGHWAY

A FEDERAL AID MISSOURI ROAD

Federal Aid Project 79 in St. Louis County, Mo., consists in the construction of 12.7 miles of concrete highway pavement with a maximum grade of 8 per cent. and 5 degree curvature. The alignment is through a hilly country with 85,000 yards of earth excavation involving a maximum average haul of 600 feet. Operations were commenced May 30 and completed October 26, 1921. Aggregate was received in railroad cars, unloaded with clamshell buckets and delivered from storage to batch boxes, hauled to the 21-E Koehring machine, which made a maximum amount advance of 1,856 square yards in eight hours. Water was delivered to the work through C. H. & E. pumps, discharging through a maximum of 28,000 feet of 2-inch pipe, and the concrete was cured by pondage and wet earth covering. The average force employed was 40 men and a payroll of about $3,000 per week.

PORT COLDEN-BROADWAY ROAD

Route 12, Section 5 of the State Highway Department, New Jersey, is a double reinforced concrete road 20 feet wide, 8 inches thick, and 3.7 miles long that is under construction by the Hudson Contracting Corporation of Jersey City for a contract price of about $225,000. It traverses a hilly country following the old location and having maximum grade of 6 per cent. and curve of 6 degrees. There are about 12,000 yards of earth excavation made with a Keystone No. 4 grader and 6-ton automobile trucks hauling spoil a maximum distance of 2½ miles. The average fill is about one foot in depth and there are six culverts. The total amount of concrete required is approximately 55,000 square yards.

Aggregate is received in railroad cars, unloaded by a locomotive crane and clamshell bucket, stored in bins and chuted from them into batch boxes, delivered to a No. 14—E Rex paving mixer timed for 1½-minute batches. The total force consisted of about 35 men and the average progress has been 300 linear feet per day. The greatest amount laid in one day of eight hours has been 792 square yards. The total weekly payroll was about $3,100 and the average number of men employed, 110. Water for the mixing, curing and other purposes was pumped by the contractor from creeks along the line. The fresh concrete was protected with canvas covers until after it had taken an initial set and was then covered with 3 inches of straw or salt hay kept wet for 14 days. The work was commenced September 22nd, will be suspended during December, January and February, and it is expected will be completed about May 1, 1922. It is being executed under the supervision of Fred L. Hartigan, general manager for the contractor, and M. M. McDougall, engineer for the State Highway Department.

AN INDIANA HIGHWAY

The Dogwood Project is a 16-foot concrete road 5 miles long with a maximum grade of 2.7 per cent., which required about 75,000 yards of black soil and clay excavation which in deep cuts was made with steam shovels, while light cuts were made with wheel scrapers and slip scrapers, the spoil being hauled a maximum distance of about 2,000 feet.

The aggregate received in railroad cars was unloaded with a clamshell bucket which delivered directly to small elevated loading bins or to stock piles, from which the same bucket reclaimed it and filled the bins as the latter were emptied. The sand and stone bins were separate structures commanded by a stiff leg derrick with 40-foot mast and 60-foot boom. Cement was delivered by cars from the same sidings as the aggregate cars and was stored in a 16x80-foot shed with loading platform alongside the industrial track that passed under the aggregate bins.

Western batch boxes of 33 feet capacity were loaded in pairs on flat cars in three 10-car trains hauled by Plymouth gasoline locomotives to a maximum distance of 5.5 miles. One full and one empty train was constantly on the road, while the cars of a third train, spotted under the bins by a rope from the derrick engine drum, were being loaded to avoid loss of time at the storage piles. The aggregate was delivered to the batch boxes through gates in the overhead bins and the cement was dumped by hand to the loading platform after the proper quantity of aggregate was placed in the boxes. Two men unloading and three men distributing the cement and aggregate sufficed for handling the 40 cars and 80 batch boxes.

The concrete was mixed in a No. 21-E Koehring paver and was finished with a Lakewood machine. The total amount of concrete required was about 23,100 yards, besides 500 yards for the culverts. The contract price was $444,947 and the weekly payroll averaged about $1,000 for an ordinary force of 50 men. The greatest amount of concrete laid in eight hours was 292 cubic yards. The work was commenced August 30th and completed November 5, 1921, under the direction of Superintendent J. R. Morgan.

PAVING IN GRAND FORKS

The Northern Construction Co., Grand Forks, N. D., laid about 91,000 square yards of concrete pavement in the streets of Grand Forks under the city supervision of J. J. Bith, city engineer, between May 1st and October 24th, 1921, and inclusive of about 30 days rain. The pavement is from 30 to 34 feet in width and has an average thickness of 7 inches. It is laid in new streets involving an excavation of about 50,123 cubic yards of rather spongy earth that was handled by a Holt 10-ton tractor hauling a small Russell elevating grader machine that delivered to from 8 to 23 horse-drawn wagons hauling the spoil a maximum distance of about one mile.

The aggregate was received in open-top railroad cars and unloaded by a steam operated clamshell bucket that delivered to a stock pile or direct to a hopper over a screen, from which the stone was discharged into a small hopper where cement and sand were added and the aggregate delivered to the ¾-yard Lakewood mixer operated by an electric motor. From the mixer the concrete was hoisted in a tower, from which it was spouted to a hopper under which ten Pierce Arrow and three Nash Quad 2-ton trucks received their 1½-yard load in about ten seconds at a maximum rate of about 40 batches per hour. The concrete was hauled an average distance of ¾ mile over a good road to the mixer, where the dumping

into the skip occupied about 30 seconds. The best record was concreting 1,824 square yards of 7-inch pavement by eight trucks in 10 hours. The best record for one week was 10,000 square yards of 7-inch pavement. The cost per yard of hauling the concrete, including the rental of trucks, drivers' wages, mechanics' wages, repairs, gas and oil, was $.65, all of the mechanics being paid $12 per day.

The force employed included 22 men at the mixer, 7 to 10 men on the trucks hauling the concrete, 14 men dumping trucks, spreading and finishing concrete, 2 carpenters and 2 laborers setting the curb, an average of 40 men rough grading, finishing the subgrade, and covering the pavement with earth, which was kept sprinkled; 1 mechanic, 1 helper and 15 teams hauling dirt.

Pittsburg Test Highway

Observations made during December. Moisture content of subsoil. Changes in dimensions of slabs due to temperature. Center of road rises during the day and falls during the night. Expansion causes a series of transverse ridges, resulting in cracks.

By Charles W. Geiger

Water has been turned into the ditches that have been built on either side of the test highway at Pittsburg, California (see Public Works for October 29, and December 10) and it is now on a level with the top of the subgrade.

Through holes provided in the concrete pavement borings were taken of the subgrade while it was perfectly dry, and other borings are now being taken (and will continue to be taken) of the wet subgrade to determine the moisture content. From observations taken in the tunnels, the relationship between the moisture content of the subgrade and its bearing power under traffic conditions will be learned. Some interesting data on the bearing power of wet and dry subgrade will soon be available.

Drawings of each of the thirteen sections of the test highway with all cracks to date chartered thereon have been sent to road engineers and others interested throughout the state of California, and each week data regarding the further development of all cracks will be sent to those receiving the drawings, thereby keeping them posted regarding the conditions of the test road.

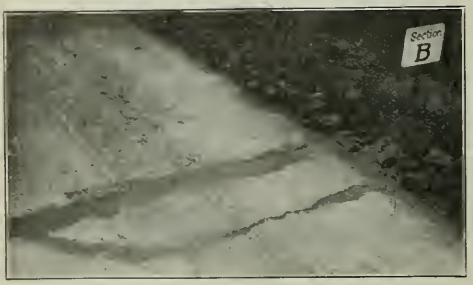
The loads carried by the trucks were increased a few days ago. At the present time seventeen trucks are operating over the test highway with a gross load of 24,500 lbs. and seven trucks with a gross load of 29,000 lbs.

While there were forty trucks at the disposal of the engineers for operation on the test highway, not all of them were kept on the track as it is often necessary to make repairs on trucks. Most of the time there were about 36 trucks in daily operation, until recently when this number was reduced to 24. From November 9th up to and including December 11th the trucks had made a total of 60,860 miles, consuming 12,646 gallons of gasoline and 1,725 quarts of oil.

Over 500 gallons of gasoline is used daily at the test highway and the supplying of this fuel is a problem in itself. The gasoline is brought to the test track in tank wagons and pumped into steel drums which are supported on special wooden racks. After the trucks have been stopped for the night, these drums are rolled onto a truck which drives alongside the trucks, supplying each with the proper amount. This requires about 6 hours each night. Two skilled mechanics are kept busy at all times in keeping the trucks in good running order.

Some time ago considerable rain fell at the test highway, and the track became covered with the adobe, which caused a number of the trucks to run off the track. In such cases a chain was attached to one of the trucks, which helped pull the derailed truck back onto the track. In a number of cases a caterpillar tractor was necessary for this purpose.

ROLLING DRUMS OF GASOLINE TO MOTOR TRUCK (SHOWN AT THE RIGHT), WHICH SUPPLIES GASOLINE TO TEST TRUCKS



SMALL SECTION OF SLAB IN SECTION B BROKE AWAY AND DROPPED BELOW LEVEL OF REST OF SECTION

Later a shoulder of brick was placed on both sides of the track for its entire length, and the mud washed off, since which time very little of this trouble has been encountered.

TEMPERATURE CHANGES IN DIMENSIONS

Ames dials (an instrument so constructed that movements as minute as 1-10,000 of an inch are detected) were fitted with a special iron jacket and used in measuring temperature changes throughout the entire width of a slab at two-foot intervals, and along both edges of the slab (which was 150 feet in length) at 6-foot intervals. Observations were carried on for a considerable period, the most important ones being obtained when the day was warm and the nights quite cool.

The results from these observations were a surprise to many of the engineers. At 1 P. M. one side of the slab was turned down .008 inch below the horizontal level of the slab and at the same hour the center of the slab was raised .01 inch above the horizontal level of the slab, thus producing greater stress on the slab, because it was resting on the subgrade at only two points of the cross-section.

At 12 midnight the condition is just the reverse, the edges being curled up .01 inch while the centers are on grade. This produces very severe conditions for the slab along the edges for early morning traffic. This condition is conducive to longitudinal cracks two or three feet from the edge.

These temperature observations were carried on over a period of 24 hours, observations being recorded every hour. It was found that the maximum vertical upward movement of the center of the slab occurred at 1 P. M. The maximum vertical upward movement of the edges occurred at 6 A. M. It was found that the slab was lying flat on the subgrade throughout its entire length at 5 P. M. and at 10 A. M.

From observations taken along the edges of slabs by means of Ames dials it was found that there existed a series of waves at the time of the highest temperature of the day, and that transverse cracks seemed to appear at the top of the waves. This phenomenon in an aggravated degree accounts for the explosions that occur on concrete pavements. This wave condition seems to point in the direction of the need of more expansion joints.

Temperatures of the top and bottom of the slabs were taken and it was found that there was a maximum difference of seven degrees between the temperature of the top of a slab and the bottom. When the temperature of the top and bottom of the slab was equal the slab lay flat on the subgrade. When the top was warmer than the bottom, the center of the slab was raised up off the subgrade.

OTHER TESTS

It was thought by the engineers that probably the surface of the test track had softened up because of the truck traffic, and in order to find out if this theory was true, they are using a hydraulic jack called a loadometer for the purpose of pressing steel balls of various sizes into the surface of the concrete. They are trying this out on concrete that has not been subjected to traffic and also on various parts of the test highway—on the middle of the slab where the truck wheels do not touch, on the edges where the truck wheels run, on sections that are broken, and on sections where cracks have appeared. This is said to be the first time that such a system has been used in such tests. In the photograph showing this test, A shows a steel ball placed under a steel plate B. Over this plate is placed the loadometer. The loadometer is placed under a heavily loaded truck, so that the top shown at C will engage one of the truck's axles, forcing the ball down into th concrete when the loadometer is operated.

The first tests of static and speed impact with an automobile passenger vehicle were successfully completed by engineers in charge of the test track a short time ago when a Studebaker "special six" touring car, with two passengers, went over the testing tunnels. Speed tests were taken at 19½, 21 and 35 miles per hour and the impact of a one-inch and a two-inch drop were both taken at 35 miles per hour.

Because of the length of the oval track, which is a quarter of a mile in circumference, safety would not permit any greater speed than forty miles per hour. However, the table reproduced here, showing the depression of the road, demonstrates that the speed impact is reduced as speed is increased. The readings were taken from the fourth testing rod, approximately in the center of the road.

CRACKS IN SECTION A, DECEMBER 15

C

B A

USING LOADOMETER TO MAKE HARDNESS TEST ON CONCRETE SURFACE

Static	.0016 in.
19½ miles	.0013 in.
21½ miles per hour	.0013 in.
35 miles per hour	.001 in.

The one-inch and two-inch drop impact readings taken at 21½ miles per hour were:

1 in. drop	.003 in.
2 in. drop	.0037 in.

The car and its two passengers, before proceeding through the test, were carefully weighed and found to scale 3,620 pounds. This weight was carried during the test.

An eight-wheel motor bus weighing about 8,000 lbs. was run over the test highway recently, and comparisons made with a four-wheel motor truck of the same weight equipped with pneumatic tires, which also was run over the track. In impact tests, the eight wheel bus only caused 70 per cent as much deflection as the motor truck. In the moving test, the eight wheel bus caused about 10 per cent less deflection than the motor truck.

Tests of other vehicles will be made after the engineers have entirely satisfied themselves as to the results of the present operations.

Recently the Motor Truck section of the San Francisco Motor Car Dealers Association sent a committee to the test highway and a series of tests were made with trailers, semi-trailers and with a low-bed truck. Some interesting results concerning these tests will be announced soon.

In charge of the entire test is Lloyd Aldrich, consulting engineer of San Francisco, aided by John V. Leonard, also an engineer, and a corps of assistants.

Pennsylvania State Highway Testing Laboratory

Makes material surveys, tests and researches and controls quality of construction materials in field and at mills.

In the ten years since its establishment, the State Highway Department of Pennsylvania has had available more than $57,000,000, all of which it is expected will have been expended by the end of next year in the improvements, construction and maintenance of the state highway department system, which by legislative acts includes more than 10,200 miles of important roads connecting county seats and centers of population, out of a total of 100,000 miles of highways in the state. The state system has been again divided into primary and secondary systems, of which the first is a combination of trunk lines, providing six north and south routes and six east and west thoroughfares crossing the state, which is about 400 miles long and 200 miles wide. Of these roads it is expected that by January 1, 1923, approximately 2,000 miles will have new, hard surfaces with a minimum width of 18 feet, a large proportion of them being concreted.

An essential feature of the proper design, construction and maintenance of this great system is the state laboratory, located in Harrisburg, which is equipped and operated mainly for testing road materials and also to control the use of these materials in construction and maintenance work, to make material surveys for the location and classification of construction materials, and for research work to aid the preparation of improved designs and specifications.

Obviously, the work of this department is directly proportional to the amount of construction and has had a very rapid development as indicated by the summary of laboratory tests, which in 1917 amounted to 1603 for 9.47 miles of highway completed; in 1918 to 1951 for 43.94 miles of highway; in 1919 to 6625 for 253.1 miles, and in 1920 to 11,671 for 413.80 miles of highway completed. The tests are made with standard apparatus and appliances and in the manner adopted as standard by the American Society for Testing Materials or, when standards have not been definitely accepted, by the methods tentatively recommended by the Bureau of Public Roads at Washington, D. C.

The testing laboratory occupies a 40x70-foot building, in the first story of which are the executive office and the chemical testing laboratory where oils, asphalt, paint and cement are investigated. A very large number of samples, averaging 600 per month, are received in this laboratory, where great care is taken to label, record, classify, distribute and store them in an accurate and systematic manner that eliminates uncertainty and confusion. This laboratory is well equipped with up-to-date supplies and apparatus.

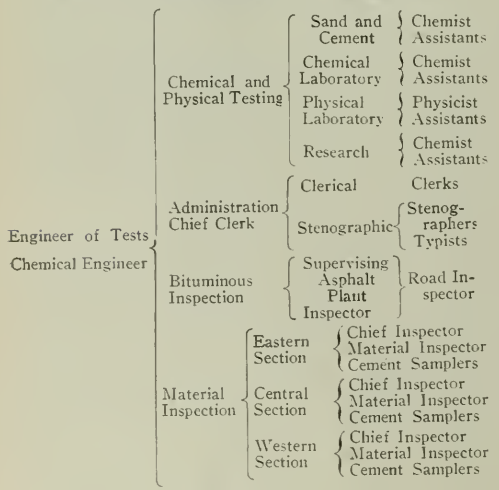
The concrete testing laboratory in the basement of the building is devoted exclusively to testing stone, brick and concrete, of which it makes approximately 500 tests per month. It has a complete mechanical equipment including a 200,000 lbs. capacity Universal testing machine; two brick rattlers, conforming to specifications of A. S. T. M., a standard impact toughness testing machine, conforming

to specifications of A. S. T. M.; a direct motor-driven diamond drill press; a U. S. standard ball grinding mill; a direct motor-driven combined diamond saw and lap; a direct driven hardness testing machine; a three-gang standard Deval abrasion cylinder machine, to determine the French co-efficient of wear on stone; a specially designed abrasion cylinder, for determining the per cent. of wear on stone; a specially designed impact machine, for determining the properties of concrete, and an impact machine to determine toughness of rock. Also screens and sieves, scales, balances, heating apparatus, wire pulling grips, cold bending apparatus, and various sizes of truncated cone moulds.

The sand and cement testing laboratory in the second story of the building makes about 2,000 tests per month, besides a much greater number of cement tests that are made in special branch offices, established by the department in the centers of the cement manufacturing industry at Allentown and at Pittsburgh, Pa. The equipment of this laboratory includes two 1,000-pound capacity automatic shot cement testing tensile machine, a standard steaming apparatus, a drying oven, three moist closets, a 20,000-pound capacity compression machine, three motor-driven sieve-shaking machines, sieves, briquette moulds, cylindrical moulds, balances and apparatus for silt and colormetric determinations on fine aggregate, sample mixer and storage tanks.

The laboratory, which is under charge of H. S. Mattimore, engineer of tests, is essentially composed of four principal divisions, those of chemical and physical testing, material inspection, bituminous inspection, and administration organization, as indicated in the accompanying chart.

LABORATORY ORGANIZATION, PENNSYLVANIA STATE HIGHWAY DEPARTMENT



Great importance is attached to the efficient application of the test results to actual construction operations. This amounts to field control of materials used, by a force of local inspectors trained to observe special qualities and defects in sand, stone, gravel and in other materials, and to determine and insist upon the necessary qualities required by the specifications. These inspectors are also furnished with field testing outfits for sand with which they can maintain constant check on the varying quality of irregular products of local sand pits and thus indicate whether they may be deteriorating or may require special selections or treatment, such as screening, washing or mixing, or if a variation in size demands corresponding change in the proportion of the mixture with other materials.

The preliminary material tests are followed up by tests of samples of finished products such as bituminous surface, specimens of which are taken from the finished roadway and sent to the laboratory to check up the mixture formula and the specified grading of materials; while with concrete surfaces two sets of cylinders, 6x12 inches and 6x6 inches, are moulded from the concrete after it has been placed in the road surface, the large cylinders being tested for compressive strength and the small ones for impact values.

RESEARCH WORK

Although some laboratory research work is carried on continually throughout the year, the most important part of it is conducted in winter when construction is slack or is suspended. At this time the services of the trained employees are utilized for the investigation of important problems which, although generally of great local importance, are in most cases common to highway construction throughout the United States.

A series of experiments are continually in progress for the study of concrete aggregate in order to determine the effect of various precentages of coal, both bituminous and anthracite, in concrete sands, some of which are found in the beds of streams that have received a large amount of waste from colleries that has produced for many miles sedimentation of minute particles of coal, which in some places is so thick and pure that it is reclaimed for fuel, while in other cases the quantity is so small as to have little effect on the qualities of sand that are essential for its use in mortar and in concrete. The concrete sand is also constantly studied to determine the mixture most advantageous to resist the abrasion and impact of traffic.

In bituminous mixtures efforts are made to develop a suitable proportion that will prevent "pushing" under traffic, and will at the same time maintain its life for a long period. Samples are taken from finished road surfaces of all types of bituminous construction and of concrete wearing surface by means of a Calyx core drill, providing samples from which action of the materials and traffic can be determined. In one 10-mile section of reinforced concrete road subjected to heavy traffic during the war, 380 cores were removed, inspected and tested and showed that the wearing surface had suffered almost no deterioration. The specimens tested so high that the usual plaster-paris capping proved inefficient, and has been replaced with cement mixed with an accelerator.

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Effects of Heat on Concrete Pavements

One of the interesting points brought out by the investigations being made on the test highway at Pittsburg, California, is the daily motion of the concrete pavement under the effect of the sun's heat. As the top of the pavement heats first in the morning, it expands first and this causes a warping of the pavement, the top becoming more convex. In the evening, as the subsoil cools less rapidly than the air, the top of the pavement contracts and becomes less convex. This of course results in decreased support, by the subsoil, of the center of the road in the daytime and of the edges at night.

Another effect, due to longitudinal expansion not sufficiently absorbed by expansion joints, is a corrugation or series of waves in the pavement, as a result of which transverse cracks form in the top of the concrete at the crests of the waves and probably in the under side of the hollows.

The data available when our correspondent wrote were by no means complete nor had the tests ended, and no conclusions are warranted, even tentatively; but enough has already been learned to promise most interesting information concerning the actions of concrete pavements under varying load, temperature and subsoil conditions.

Hydrogen-ion Concentration

The term "hydrogen-ion concentration" is finding its way with increasing frequency into the literature of water purification, and those interested in that subject should at least know what is meant by it and the application of the procedure involving the use of the theory that has been given this name. Any filter attendant can, we believe, understand the explanation given in this issue on page 28.

That it is still a new idea to the majority of water works men is indicated by the fact that, in the discussion of the subject before the New England Water Works Association, the chemist and sanitary engineer of the Rhode Island State Board of Health stated that "The question of hydrogen-ion concentration of water is so new as a practical water works proposition that I have had little opportunity to look into it." It is therefore believed that the explanation we print will be welcome to many of our readers.

Co-ordination of Laboratory Tests and Field Inspection for Highway Construction

The construction of any considerable mileage of hard surface roads, particularly those with bituminous or concrete wearing surfaces, requires a thorough laboratory service in the testing of constituent materials to grade them in accordance with accepted standards, establish their conformity to the required specifications, determine if they are satisfactory for acceptance in given construction operations, and to make preliminary investigations of their suitability for proposed work or of modifications in proportioning and treatment that may make them acceptable for revised specifications.

Most or all of the state highway departments recognize this necessity in the development and operation of official testing laboratories, but they do not all attach great importance, or give in every case sufficient weight, to the necessity for a thorough coordination of the laboratory with the current construction operations which, for the best results, should be coordinated with the laboratory by making the inspectors and field engineers constantly and intelligently responsive to the daily local conditions and operations.

In other words, the established theoretical requirements should be continually compared with the construction operations so as to secure thorough and accurate control of the materials actually used and the mechanical processes involved at all local points. The chief essentials to this are to verify the conformity of the materials used with those of the accepted and specified samples, and to check the proportions of different materials and approve the operations of construction so that the value of satisfactory materials may not be impaired or deteriorated by neglect or improper treatment or proportioning.

The quality and proportion of cement may generally be determined by careful continuous supervision of the mixing machine and by proper requirements for hauling, storing and handling the cement that is tested at the laboratory and mills. Bituminous materials require constant testing and inspection at the mixing plant and temperature tests at the site.

Broken stone requires approval of the source, which is usually sufficiently supplemented by careful inspection as to uniformity of product.

Sand and gravel are often procured from local deposits, frequently from many successive ones that are likely to furnish a variable output having great irregularity. The initial samples accepted by the laboratory may be very different from the materials frequently encountered which are likely to have constant minor variations, therefore the local inspectors should be especially trained in the accurate observation of the general characteristics and should be furnished with simple field testing plants enabling them to keep constant watch over the regular deliveries and immediately report any serious variations from the accepted standards, which should be immediately submitted to the engineer in charge and instructions received whether material is to be accepted, or rejected, or the proportions changed.

Such inspection tests in combination with the selection, recording and testing of samples taken regularly from the finished structure will operate to establish the best co-operation between contractor and engineer and secure the greatest advantage from the preliminary laboratory work and the best conformation with the specification requirements and principles of design. It involves very little additional trouble or expense and is an important element in realizing the potential value of the laboratory tests and specification requirements.

Hydrogen-ion Concentration in Water Purification

Comprehensive, concise and clear explanation of what is meant by this new term in water purification nomenclature, and how the idea is employed in regulating coagulant doses.

The introduction of hydrogen-ion concentration in the procedure of water purification by rapid filtration is perhaps the latest development in the science of water purification, or rather in the control of purification, and is as yet understood by few engineers and water works superintendents. The following explanation, written by Harrison P. Eddy of the firm of Metcalf & Eddy, consulting engineers, is the most complete and clear that we have read, and is given here to enable the readers of this paper to obtain a clear idea of a subject to which they will probably see references with increasing frequency in the future. This description was presented by Mr. Eddy as a paper before the New England Water Works Association last September. It was followed by a discussion, from which also a few ideas have been taken to supplement Mr. Eddy's paper.

The term *hydrogen-ion concentration,* for short written also "H-ions" and "PH," may with sufficient accuracy for popular purposes be paraphrased *concentration of acidity or alkalinity,* as the case may be. Pure water is neutral,—that is, neither acid nor alkaline; and its hydrogen-ion concentration is taken at 7. Acidity is designated by numbers below, and alkalinity by those above 7.

The acidity or alkalinity of a liquid has thus far generally been reported in terms of total quantity of acid or alkali present. It has commonly been determined in water by adding acid or alkali of known strength, in sufficient quantity to neutralize the original acidity or alkalinity, the neutral point being indicated by a change in color due to a small quantity of organic dye previously added. But the action of the acid is not due solely to its total quantity but rather to its effective quantity or intensity. The essential difference between this old determination and the new hydrogen-ion method is that the latter shows the intensity, or true acidity, rather than the total quantity of acid.

The function of alum in the process of water purification is to produce a coagulum, or floc, of relatively large size, capable of absorbing or enclosing the finely divided foreign substances which cannot be removed by practicable periods of sedimentation or by filtration at high rates. When absorbed by the alum floc, however, they may be removed readily by sedimentation or by filtration, or by both processes jointly. It is obviously important that the alum introduced into the water be converted into floc as completely as possible.

It has generally been supposed that the precipitation of the sulphate of alumina is dependent primarily upon the presence in the water of sufficient alkali, and that any excess of alkali likely to be present in waters generally used as sources of water supply is not disadvantageous. However, certain experiments indicate that there is an optimum point at which apparently all of the aluminum is thrown out of solution, but that above that point on the side of alkalinity or below it on the side of acidity precipitation is not complete. This offers a plausible explanation of the presence in the water being treated of aluminum both in insoluble and soluble form at the same time and of the frequent occurrence of dissolved aluminum in filtered waters. It certainly indicates that it may be highly important, if practicable, to carry out the coagulation process at the optimum point of alkalinity,—the isoelectric point. Without this determination, or its equivalent, it is impossible to know whether the water has the proper PH. It may be too low or too high for complete precipitation

and it will probably only occasionally be just at the optimum point.

The presence of aluminum in two forms is explained by some according to the theory that the alum assumes a colloidal condition, by which is meant a condition intermediate between solution on the one hand and suspension on the other. Thus we may speak of salt dissolved in water, as a solution, and sand or fine silt suspended in water, as a suspension. The soap in soapy water may be taken as a popular illustration of the intermediate condition—that is, the soap is a colloid. Some substances, like the alum used in purifying water, may be in, or be changed into, any one of these three conditions. The change is one of condition rather than of composition.

Another theory is that the alum may exist as different chemical compounds, some of which are soluble and others insoluble.

Whichever of these theories may be accepted, the important point is that the alum can be converted completely into insoluble aluminum hydrate only within a narrow range of hydrogen-ion concentration, which is not indicated by the methods commonly used for determining alkalinity, and that either above or below this zone the aluminum, or a portion of it, may be present in solution.

It follows, therefore, that it is as important to reduce an alkalinity which is too high as to increase an alkalinity which is too low. This introduces a step in the process of the treatment of water which is not common and which may prove of material value.

It is hardly necessary to point out the fact that the hydrogen-ion concentration appertains to the condition of the water for satisfactory coagulation and is not a method for determining the quantity of coagulant required. This must be done as an entirely independent step in the process.

For ascertaining the isoelectric point the determination of the hydrogen-ions affords a convenient and practical means. This may be accomplished in a manner similar to that long used for the determination of the total quantity of acid or alkali present. Thus, by the use of several indicators constituting virtually a scale of indicators and by the addition of the proper quantity of alkali, or other compound, it is possible to bring the water to the exact hydrogen-ion concentration required for complete precipitation of the aluminum from the alum added to the water. Theoretically, this may be so minutely controlled in practice as to prevent the occurrence of dissolved aluminum in the presence of the insoluble aluminum floc.

As the difference in electrical pressure or potential between any metal and its ions varies with the concentration of those ions, it is possible to determine this concentration by means of suitable electrical apparatus, one form of which is known as the "potentiometer." By the use of the hydrogen electrode,* therefore, it is possible to determine the concentration of the hydrogen-ions.

In order to take advantage of the hydrogen-ion concentration in the operation of a water purification plant, it will be necessary to control the chemical treatment according to several steps, such as—

1. Determine the quantity of alum required for successful treatment under conditions prevalent at the time.

2. Determine the PH of the water to be treated.

3. Determine the quantities and kinds of chemicals to be introduced, in order to bring the water to the isoelectric point for coagulation of the aluminum.

The procedure, then, would consist of adding the proper kinds and quantities of chemicals to produce the isoelectric point and the required quantity of alum for the successful treatment of the water.†

The quality of most raw waters varies from time to time,—often materially within very short periods of time. This variation may be in bacterial content, organic matter, numbers of micro-organisms, turbidity, temperature, or in all of these. It is obvious, therefore, that the quantity of alum must be varied to meet the conditions at the time. It is highly probable, also, that the PH varies greatly and that the kinds and quantities of chemicals used to produce the isoelectric point must be varied accordingly. Even if the PH of the raw water remained constant, the necessary changes in the quantity of alum introduced would make it necessary to vary the chemicals required for producing the isoelectric point, as this condition must be fixed with reference to the quantity of alum used; or, in other words, if coagulation is to be complete the water must be at the isoelectric point after the sulphate of alumina has been added.

It has been suggested that the PH of the water may be determined and the application of the conditioning chemicals regulated automatically by electrical apparatus. Such equipment would greatly simplify the control of the process.

Among the advantages which may possibly result from PH control of water purification plants may be mentioned the following:

1. Prevention of passage of alum through filters and after-precipitation in mains.

The passage of alum either in solution or as a colloid through water filters has long been recognized as one of the defects of the alum treatment. Such water is not satisfactory for domestic consumption and is objectionable for certain industrial uses, such as dyeing. It may be possible by chemical treatment to so adjust the PH as to secure complete precipitation of the alum and prevent its passage through the filters.

2. Prevention of corrosive action.

It is possible that the treatment of the water to secure the isoelectric point will reduce the danger of corrosive action by the filtered water, due either to the presence of dissolved aluminum sulphate or to excessive carbon dioxide. The treatment required to produce the isoelectric point in some cases (where acid is required) might not reduce—in fact, it might actually increase—the amount of free carbonic acid present in the water. It does not follow, therefore, that in all cases advantage can be taken of reduction of both of these corrosive substances, although it may be possible to so adjust this treatment as to accomplish this. It is conceivable and has been suggested, however, that in practice water treated in this manner might become more highly corrosive than that treated in the ordinary way.

* Because metallic hydrogen cannot be obtained, an electrode is used which is covered with spongy platinum saturated with hydrogen.

† In the discussion Mr. Eddy stated that the isoelectric point is not coincident with P-H-7 or the neutrality point, but varies with the material to be coagulated.

3. Control of small plant and animal life.

It has long been known that the growth of microscopic organisms and bacteria is favored by the concentration of acidity, within certain limits, outside of which there is an inhibiting effect. It has been suggested that by securing the optimum PH for precipitation of alum, the environment of such organisms may be so changed as to prove detrimental to them and inhibit their growth. There is scarcely any definite information on this point and it is included herein merely as a suggestion of possible means of controlling growths in filter plants, which in some cases have been quite troublesome.

4. Possible reduction in size of filter plant.

It is a matter of common knowledge among chemists that precipitates formed under certain conditions settle and filter much more readily than those formed under other conditions. There seems to be ground for the belief that alum precipitated at the optimum PH point may form a floc which will settle more readily and permit of more rapid filtration than similar floc formed at a less favorable PH. Should it prove that coagulation at the isoelectric point will produce a floc which will coagulate and settle more readily and permit of a higher rate of filtration, a corresponding reduction in size of coagulation basins and filters might prove a substantial advantage. While it is conceivable that the change in the character of floc, due to PH control, might warrant a change in the depth of filtering material or in some other detail of construction, this does not appear at all probable.

5. Possible increase in efficiency of operation.

If coagulation at the isoelectric point will result in the formation of a better floc and in avoiding the passage of dissolved aluminum through the filters, it may be that the bacterial efficiency of filtration will be improved to some extent. It seems reasonable to expect such a result from observation of the process of coagulation.

While these and perhaps a number of other advantages of the PH control may be possible from a theoretical point of view or may be obtained in the laboratory, it is important to prove to what extent, if any, they can be secured in the practical operation of water purification plants.

There is little doubt that the determination of the hydrogen-ion concentration will permit of a more intelligent study of the water and the reactions taking place during its treatment. This fact alone is sufficient to warrant making a thorough investigation of the subject and determining the PH value in many cases.

It is possible that the methods of control now in use, based in part upon the older conceptions of the chemistry involved and in part upon practical operating experience, permit of as close operation of purification plants as it is possible to obtain, even with the assistance of the more delicate and refined hydrogen-ion determinations made in accordance with the latest theories of chemistry.

It often happens that empirical methods lead to practical results which are as satisfactory and effective as those based upon more accurate knowledge. This fact, however, does not justify disregard of progress in science and of new theories. It cannot be gainsaid that the older practitioners in any profession, or in the arts, are inclined to adhere to the older methods and processes as a result of their familiarity and experience with them and a natural reluctance to adopt new ideas. The older members of the profession should constantly guard against this tendancy, in order that valuable improvements may not be ignored, simply because they involve new discoveries and new theories.

While it is wise to give proper weight to the reasonable doubt of success in order not to be misled by theoretical considerations, it is certain that the subjects of coagulation and filtration should be very thoroughly studied in the light of the more modern chemical theories. Such investigations will lead to a better understanding of the chemistry of coagulation than that which has governed this important subject in the past. With improved conception of the process, advantages of more or less importance are likely to follow. The true value of the hydrogen-ion determination can only be learned through investigations covering a great variety of conditions encountered at a large number of plants.

Such investigations may well lead to a re-study of the whole subject of chemical treatment of water, and improvements may result in lines entirely apart from the hydrogen-ion determination.

In discussing this paper, Frank W. Green, superintendent of the Little Falls filtration plant of the Montclair Water Co., defined hydrogen-ion concentration, as applied to natural waters, as being "the measurement of the minute amount of hydrogen which is present in the ionic state due to electrolytic dissociation. Pure water has a value of P.H.-7.0, but natural waters may vary from 6.0 to 8.0. Although present in almost inconceivably small quantities, its determination is of considerable value because coagulation, corrosion, and other important reactions take place in definite zones of hydrogen-ion concentration. The result obtained for any given water depends upon the proportions of the contained amounts of certain acids and bases, those of greatest influence in normal supplies of this region being the free carbonic acid and the bicarbonates. So important are these two constituents that $3CO_2$ divided by HCO_3 will give a rough approximation of the H-ion concentration."

Mr. Green said that "the actual determination of the PH value of a given water is one of the most simple tests that the water analyst has to perform, provided he takes advantage of the permanent standards and indicator solutions now on the market. The test consists in adding a few drops of the indicator to the water sample and comparing its color to that of the standards." The theoretical side of the subject, however, is very complex and difficult and can be undertaken only by the most skilled specialists.

With reference to actual use of this method, Mr. Green stated that "for routine work, quite accurate results can be obtained by use of the sets of Brom thymol blue standards with a range of 6.0 to 7.6 and phenol red series of 6.6 to 8.2 in sealed test tubes. Bottles of solutions of the two indicators and color charts to insure that the standards are correct can be purchased for a small amount. Take 10 c.c. of the water to be tested, add a few drops of the indicator, and compare with the permanent standards.

Constructing Wichita Falls Sewers

Thirty-six miles of machine trenching up to twenty-two feet for sewers six to thirty-nine inches in diameter. Four excavating and three backfilling machines used on $750,000 job.

The new sanitary system of Wichita Falls, Texas, has just been installed in about fourteen months by C. R. Nichols, Wichita Falls, Texas, at a contract price of $750,000, the largest undertaking of its kind that has yet been accomplished in the state of Texas.

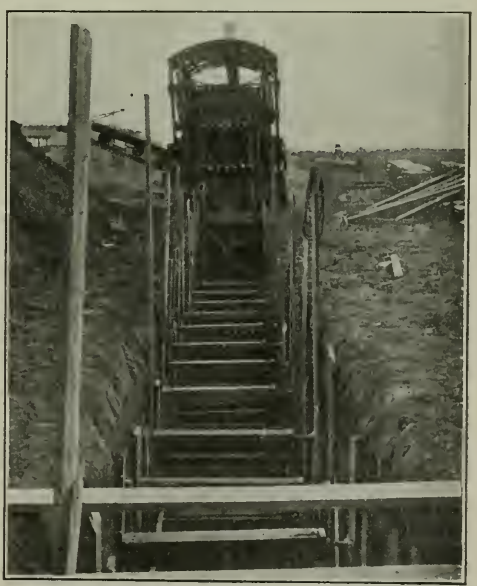
Starting at the outfall with 6,800 linear feet of 39-inch segment block sewer and a maximum depth of 22 feet, the system includes 6,000 feet of 36-inch,4,000 feet of 33-inch, 4,000 feet of 30-inch, 8,000 feet of24-inch, 11,000 feet of 18-inch, 14,000 feet of 15-inch, 7,600 feet of 12-inch and 100,000 feet of smaller sewers.

The trenches were excavated chiefly through hard red clay with some quicksand, by four Bucyrus, Austin and Buckeye excavating machines. The widest and deepest trenches, those for the 39 to 33-inch sewers inclusive, were excavated by a Bucyrus Class 72 machine, weighing 99,000 pounds that made a record of 61½ linear feet of completed trench 5-feet wide and 21-feet deep in 60 consecutive minutes and has made an output of 333 cubic yards per hour in hard clay. The machine is equipped with a 20-foot ladder, for buckets 24 to 72 inches wide, although 48-inch buckets were the smallest used on this job. The spoil was handled by an independent conveyor engine making it possible for the operator to regulate the location of the spoil pile and dump the material far enough from the center of the trench to prevent overloading the bank and consequent caving in of the side of the trench. The trench for the 18-inch sewer was excavated by an Austin machine; that for the remainder of the sewers was excavated by Buckeye machines.

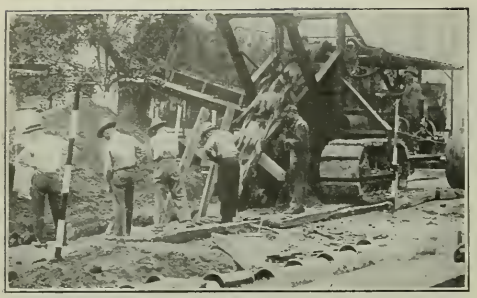
Between November 23, 1920 and February 14, 1921 the total machine excavation amounted to 90,581 cubic yards for which the cost, exclusive of repairs and depreciations was only $3,719.90 including labor and fuel. The center of the spoil bank was maintained from 12 to 18 feet from the edge of the trench and the soil was so dry and firm that the sides stood vertical although sheeted, where the trench was more than 10-feet deep, with vertical 2 by 12-inch planks, not close together, braced with screw extension, horizontal struts set directly against the planks or set against waling strips 5 feet apart vertically.

The bottom of the trench was trimmed by hand to a concave surface corresponding with the sewer inverts and the center line of segment blocks was laid and tamped to grade and the longitudinal courses on both sides were laid simultaneously and tamped up to the spring line, after which forms 12 feet long were set and the arches were built on them, the forms collapsed, and advanced as fast as the trench was excavated, thus completing the sewers as fast as the digging permitted. The trench was backfilled with

BUCKEYE MACHINE CUTTING SEWER TRENCH 30 INCHES WIDE, WITHOUT SHEETING. BACKFILL FOLLOWS CLOSELY



BUCYRUS MACHINE EXCAVATING 60-INCH TRENCH 20 FEET DEEP FOR SEGMENT BLOCK SEWER. BACKFILLED BY MACHINERY



BUCKEYE MACHINE EXCAVATING NARROW SEWER TRENCH 10 FEET DEEP

three Austin, and one Buckeye machine, one Cletrac tractor and one Holt tractor.

The force employed varied from 50 to 150 men under the direct charge of C. R. Nichols, assisted by R. C. Nelson, chief engineer; C. C. Key, office engineer; W. A. McRae and W. L. Robb, superintendents, and J. L. Poole, master mechanic. During construction several changes occurred in the personnel, and D. T. Ferrell succeeded C. C. Key, and M. M. Buchanan succeeded W. A. McRae.

Reservoir Storage for Kansas—Colorado Water

Report of Committee of Kansas Engineering Society on joint state action for conserving flood waters of the Arkansas River.

The Arkansas river is used by both Kansas and Colorado as a source of water, for irrigation chiefly. A large percentage of the water is lost during flood times because there are practically no storage basins, either natural or artificial. Effort is being made to obtain combined action by the two states which would result in the construction of reservoirs for storing flood waters to the advantage of both states, but chiefly of Kansas, during seasons of minimum stream flow.

The possibilities are being studied by engineers and state officials, and a committee of the Kansas State Engineering Society, consisting of G. S. Knapp, H. B. Walker and O. E. Noble, has recently reported on the subject. The following quotations and abstracts are from that report:

PHYSICAL CONDITION OF RIVER FLOW

"According to records from the river gauge maintained by Colorado on the Arkansas river at Holly, and which are now available for the ten year period, 1911 to 1920, inclusive, there is an average annual flow across the state line into Kansas of about 220,000 acre feet of water annually. The largest amount was 555,955 acre feet in 1914, and the smallest 54,557 acre feet in 1917. There were only two years when the total flow was less than 100,000 acre feet. No general tendency to either increase or decrease is evident.

"Without storage a large part of this water is lost because it comes outside the irrigating season or in floods of such volume that all of the Kansas ditches can divert but a small part of the flow. Complete information on the total combined capacity of the Kansas ditches is still lacking, but it is probably not far from 650 cubic feet per second. Assuming this figure correct, and that when the river flow drops below 40 cubic feet per second it will not make an irrigating 'head,' an examination of the daily gauge records for the period in question shows that the Kansas canals probably received an average of only 68,000 acre feet of water annually, or only about 1.13 of an acre foot per acre for the land under them, not deducting canal losses between the point of diversion and the land. The largest part of the water, 153,000 acre feet, or approximately 70 percent was lost for the reason that it either came out of the irrigating season or in such large volumes that the canals were able to take only a small portion of the flow. The largest loss was by summer floods, amounting to an average of 95,700 acre feet annually. Winter flow amounted to an average of 57,900 acre feet. There was a greater regularity in the amount of winter flow than of summer flow, but even the latter was subject to considerable variation. The largest flow for the five winter months in any year was 82,500 acre feet in 1912, and the smallest 27,700 acre feet in 1918.

"With the exception of 1914 and 1915, which were flood years compared with the past year in volume of water, almost the entire flow of the river could have been controlled by storage. If stored, the water would have been more than enough for the land now under ditches. Lack of adequate reservoir sites has made storage of the water after it reaches Kansas impossible, and Colorado laws forbidding the removal of water from the state have in the past prevented storage in Colorado for use in Kansas.

RESERVOIR POSSIBILITIES

"The Purgatorie river in Colorado seems to offer the most promising solution of the storage problem. This stream is one of the larger tributaries of the Arkansas in Colorado. It rises in the high mountains west of Trinidad, and flows in a northeasterly direction for one hundred and forty-five miles, entering the Arkansas below Las Animas, sixty-five miles west of the Kansas-Colorado state line. Because of the topography of the surrounding country, and the fact that it enters the Arkansas below the headgates of most of the Colorado ditches, this stream has been less extensively developed for irrigation than most other Colorado streams. Above Trinidad the country is mountainous. Twenty-five miles below Trinidad the stream enters a rocky canyon, the walls of which are more than three hundred feet high, and it does not emerge from this canyon until it has nearly reached its junction with the Arkansas. Immediately below Trinidad the valley for a short distance is comparatively broad and level. Here there is a considerable acreage of irrigated land. Farther down,

about fifteen miles above Las Animas, the canyon widens into a valley a mile or more in width. At this point there are two small appropriations for use on the bottom land adjacent to the stream.

"Few measurements of stream flow have been made on this stream. It is well known, however, that the Purgatorie, like most mountain streams, is subject to sudden floods of great volume, and on the other hand, has but little dry weather flow. Records available for the three years, 1910 to 1912, inclusive, at Trinidad, show an average flow of 69,500 acre feet of water. None of these years were flood years. It is probable that the discharge in flood years is much greater, and it is also probable that there have been years when the annual flow has been less than the above amount."

The Purgatorie has two very good reservoir sites, one just above the point where it enters the canyon, where a dam 250 feet high would impound 1,367,000 acre-feet of water—more than the capacity of the Roosevelt reservoir. The other site is thirty-five miles lower down, at the junction of Chauquaqua creek with the river. Here a dam 150 feet high would impound 605,000 acre-feet.

Other sites have been located at Medway and at Hartland, Kansas, but these are not nearly so advantageous. Near Lakin, Kansas, is a reservoir that has been in use for some years and would be of some value in connection with the water problem.

Chlorination Tastes and Odors

Experiences at the filtration plant at Grand Rapids, Mich., from 1917 to 1921, were discussed in a paper before the American Water Works Association by Walter A. Sperry and Lloyd C. Billings, chemists of that plant. In this paper the writers reviewed their experiences with chlorine disinfection during the five years named and their success in eliminating tastes and odors in the water that were occasionally caused by chlorination.

In view of certain features in design of the plant and quality of the raw water, it was found necessary to add the chlorine at a point between the settling basins and the filters. During 1918 and 1919, when complaints regarding taste and odor had occurred, liquid chlorine was being used entirely or in conjunction with hypochlorite. In 1920 hypochlorite alone was used and there was no trouble from tastes and odors. Investigations showed that the trouble had been due to the fact that, when applying liquid chlorine (which is a 100% solution), a small fluctuation in dosage was sufficient to exceed the narrow range between the amount of chlorine required for proper disinfection and that necessary to produce taste; while in applying hypochlorite, of which much larger quantities are used because of its lower chlorine content, it was easier to keep within the narrow range between these two points.

In 1920 and 1921 laboratory tests were made to determine the proper methods of feeding the chlorine by laboratory control rather than at a constant rate. It was found that a modification of Wolman and Enslow's chlorine absorption method gave a satisfactory disinfection result without taste and odor complaint. The method referred to is based on the hypothesis that "a proper dosage for the effective disinfection of a water is the amount equal to that absorbed by the water tested after contact of five minutes plus a factor of safety to 0.2 p.p.m. (as a tentative value)."

Judging from their own experiments, the writers did not believe that 1.1 p.p.m. of chlorine could be left in the Grand Rapids filtered water without producing taste, although certain tests for residual chlorine and taste appeared to indicate the contrary. They concluded from their experiences that "the whole problem of chlorine tastes as applied to filtration practice is related to improperly proportioned dosages."

Asphaltic Concrete Foundations

The following is part of a letter by P. J. M. Larranaga, of London, published in "Municipal Engineering and the Sanitary Record" for December 22, as part of a series of letters on that subject which are appearing in the "Correspondence" columns of that periodical:

"The fact that a certain type of construction has stood the traffic of years gone by does not prove its efficiency under the impact of modern traffic. Waterbound macadam has served its time and passed out, and it is now the turn of the rigid foundation to pass out, because the heavy motor truck has brought a new destructive force, the impact of concentrated loads, to bear upon road surfaces.

"It is no longer a question of static loads rolling along, or of self-propelled vehicles disturbing the crust of the road. These forces have been attended to. The question now is how to devise a means of resisting the terrific hammering and pounding that a road surface receives. An ordinary omnibus rider can testify to the existence of this force, but what he feels is greatly attenuated by the springs of the vehicle. There remains, however, a great amount of unsprung weight of vehicles, the impact of which, plus the reaction of the springs, has to be absorbed by the road surface. Is it not clear that the road surface material should likewise be cushioned?

"When we lay a concrete foundation we actually build a rigid bridge, when we should instead be providing only a resilient yet stable medium for transferring the load to the bearing soil of mother earth, which is the ultimate foundation.

"Bituminous structures develop great slab and beam strength, as measured by their resistance to impact. The all-asphalt slab and beam offer considerably more resistance to impact than an equivalent thickness of 1 : 3 : 6 Portland cement concrete, considered either as an integral structure or as a foundation for a bituminous wearing surface. It is uneconomical and impracticable to try to secure a permanent bridging of weak sub-grade. Though the bituminous type of construction has been found to develop such action to a considerable extent, it is characteristic of it that it eventually seeks to maintain contact with the sub-grade, thus to reinforce itself with the maximum supporting value of the latter. The rigid type cannot do this and will therefore crack if unsupported.

"Nor can this be improved by making the concrete mixture richer, for while the beam strength may increase, the expansion and contraction stresses increase much more, and with them the resulting

liability to cracking on that account alone. We say nothing of the much greater cost of such rich concrete.

"In conclusion, it cannot be too often repeated that the first and most important consideration in all road construction is to increase the bearing power of the subsoil to the maximum by providing proper drainage with uniform and thorough compaction. Where a very poor clayey soil exists, difficult to drain, and having great capillary attraction for water, it is often more efficient and economical to modify the character of the subsoil to a sufficient depth by mixing with sand or other suitable material, than to embark upon an expensive and massive design to bridge the defect.

"Concerning the suitability of an asphaltic foundation for an asphalt surface, the preceding arguments are reinforced by the consideration that in such a case we secure perfect adhesion between surface and foundation and a practically homogeneous structure throughout."

In England nearly all the sheet asphalt, except in the city streets with the heaviest traffic, is now being laid on bituminous concrete base, and this method is said to be satisfactory because of the existence of a firm sub-base of old macadam.

Nearly One Thousand Miles of Roads Constructed in Kentucky in Two Years

The fifth bi-annual report of the Kentucky State Highway Department shows that 990 miles of various types of roads were built during the years 1920 and 1921. Of this amount about 300 miles were surface treated old macadam road and 690 miles were new and resurfaced roads. About one-half more work was done this year in 1921 than 1920. Lack of co-operation between the prison and road departments, as well as the decrease in wages for free labor from $5.00 to $1.50 per day in some localities, has caused the State Highway Commission to discontinue the use of convict labor. In 1920 about 29½ miles of convict-built road cost about $6,000 per mile while in 1921 about 34 miles cost more than $10,000 per mile.

During 1921 the State Road Department received $1,350,000 from county appropriations and private subscriptions, a larger sum than almost any other state in the union has received from similar sources. In 1921 the state also received $1,951,755 from Federal Aid allotment.

Snow Removal on New Jersey State Highways

There are about 725 miles of road in the New Jersey State Highway System, and the State Highway Commission plans to keep 402 miles clear of snow during the coming winter. This portion of the system is divided into 31 sections from 9 to 17 miles long and each section is provided with three 2-ton or 5-ton Nash 4-wheel-drive trucks with a Good Roads snow plow attachment for each.

Each section is assigned to a principal contractor who has work for the department or other work in the vicinity, and keeps in constant touch with the central office, from whom he receives notice eight or ten hours in advance of the approach of a severe snow storm. When he receives the snow call he immediately assembles his organization and proceeds to the truck station and awaits a 2-inch depth of snow to commence operations. If it proves to be a false alarm he is paid for the time of waiting.

Sustained Rapid Concrete Highway Construction

The construction of 8.3 miles of 20-foot concrete highway on Route 6 of the New Jersey state highway system between Shirley and Bridgeton during June, July and August of last summer, involved laying 23,000 cubic yards of concrete, besides making 15,000 yards of excavation and building 5,547 linear feet of combined curb and gutter 5 feet wide, together with ordinary draining and guard rail work. The contract was awarded June 1st to the Tri-State Construction Co., Bridgeton, N. J. Grading was commenced the next day, the first equipment was installed June 19th and the first concrete was laid July 6th. In the first week 785 linear feet of concrete was laid by a totally inexperienced crew and foreman, in the second week 854 feet, and by the fourth week an average progress of 300 linear feet per day was maintained.

Two Ransome No. 21 caterpillar mixers were used. One of the mixers was worked on double shift, the first gang working from 4 a. m. until 12 noon, and the second from noon until 8 p. m., finishing by artificial light. This mixer laid 25,600 linear feet of pavement in 75 working days.

A third Ransome mixer was kept in reserve. The other principal equipment installed included seven Plymouth locomotives, 30,000 feet of 24-inch industrial track with 8 switches, 62 cars and 124 batch boxes by the Light Railway Equipment Co., one 5-ton Best tractor, one 10-ton Holt tractor, one Adams scarifier grader, two Marion No. 21 steam shovels with clamshell bucket, to unload sand and stone, one Keystone grader and two 10-ton steam rollers.

Aggregate was loaded into the batch boxes through gates in the roof of tunnels carried under the stock piles of 2,000 tons capacity for stone and 1,000 tons for sand. The three mixers and the industrial track were maintained in excellent condition by a 23-man track gang constantly on duty and the trains were run on schedule at a speed of 8 miles per hour.

Grading was done with 32 men, 3 foremen and 6 teams, the hauling equipment was operated by 16 men, one foreman and 16 men were maintained at the unloading plant, and 81 men and 3 foremen operated the two mixers, set the forms, did the fine grading and other work connected with concreting. The total maximum force employed was 167 men, 9 foremen and one superintendent. The concrete materials actually used corresponded with those theoretically required within 0.014 per cent. The work was executed under the direction of J. A. Williams, division engineer in charge of state highway construction in southern New Jersey, with a local force consisting of a 3-man survey party and 6 inspectors constantly on the work.

Recent Legal Decisions

OWNER'S COMPLAINT THAT ADVERTISEMENT FOR BIDS EXCLUDED ALL BUT SUCCESSFUL BIDDER NOT CONSIDERED

In a suit against a construction company and the city of Albuquerque to enjoin road construction work, the New Mexico Supreme Court holds, Ellis v. New Mexico Construction Company, 201 Pac. 487, that complaint to the effect that the advertisement for bids contained such terms that only the defendant construction company could have proposed to do the work and could have performed could not be considered, there being no allegation of fraud or collusion, or of injury to the plaintiffs or any property owner interested, or of other substantive facts which would go to negative the presumption that the city performed the duty imposed upon it by statute by letting "the contract for the doing of such work and the furnishing of all necessary materials to the lowest bidder." The allegations of the complaint were not necessarily inconsistent with the actual performance of the duty imposed.

ANNEXED PROPERTY MUST BE PROPERLY SUBJECT TO ANNEXATION TO VILLAGE

The Minnesota Supreme Court holds, State v. Village of Buhl, 184 N. W. 850, that, in a proceeding under Gen. St. 1913, §1800 et seq., to annex territory to a village, the property annexed must be so conditioned as properly to be subjected to village government. Whether it is so conditioned is primarily for the voters; but if their action is clearly arbitrary, for the purpose of increasing sources of revenue rather than of subjecting to the local village government property having a natural connection with it and people residing thereon having a community of interest, the courts will not sustain it.

MUNICIPALITY CANNOT ACQUIRE SEWERAGE DISPOSAL PLANT IN ANOTHER MUNICIPALITY WITHOUT CONSENT OF LATTER

The New Jersey Court of Errors and Appeals holds, North Jersey Utilization & Sewerage Disposal Plant v. Van Buskirk, 115 Atl. 215, that, under the New Jersey Home Rule Act, a municipality cannot maintain proceedings to acquire land for a sewage disposal plant in another municipality without the consent of the governing body of the latter municipality and its board of health, or, in case of their refusal, without the reversal of such refusal by the State Department of Health. It is immaterial that the object is to acquire a plant already completed, in place of land on which to construct one. The lands desired in this case are part of the territory formerly occupied by the army cantonment called Camp Merritt, on which army engineers built a complete disposal plant.

LIMITATION OF TIME FOR ACTION FOR INJURY TO LAND FROM DRAINAGE SYSTEM

The Illinois Supreme Court holds, Schlosser v. Sanitary District of Chicago, 132 N. E. 291, that injury caused to land by the existence and duly authorized operation of the drainage canal of a sanitary district, which canal is a permanent structure, whose use and operation in such manner are necessarily injurious to the land, is a permanent injury, and all damages therefrom, future as well as present, must be recovered in one action, to be brought within five years after the completion of the work and putting it in operation.

CARRIAGE OF WATER BY ONE UTILITY FOR ANOTHER NOT A PUBLIC UTILITY SERVICE

The Colorado Public Utilities Commission holds that the carriage of water by one utility for another is not such a service as is contemplated in the terms of the Colorado Public Utilities Act, so as to make such service the subject of regulation and control of the Public Utilities Commission; and that the City of Durango is not performing a public utility service when it is carrying water for and to Animas City when such water is owned by Animas City.

TAXATION OF STREET RAILWAY PROPERTY

The Washington Supreme Court holds, Puget Sound Power & Light Co., 201 Pac. 449, that Laws 1907, c. 78, §12, as amended by Laws 1911, c. 21, providing for taxation of operating property of street railroads as personal property, is not violative of constitutional provisions as to uniformity of taxes, notwithstanding the taxation of the land of commercial steam railroads as realty. There is no vested right, either in a corporation or natural person, to have property assessed in any particular way. Such matters rest entirely within the control and discretion of the Legislature. It is a question of uniformity and equality in the classes. That there is ample reason for the classification made by the statute in this case is easily seen. Street railways have no fee in the streets, and their properties are largely personalty, while the commercial steam railways own their rights of way, and own extensive freight yards, terminal and station grounds.

INSUFFICIENT NOTICE OF INJURY FROM DEFECT IN STREET

The Wisconsin Supreme Court holds, Hogan v. City of Beloit, 184 N. W. 687, that a notice to a city that the plaintiff had, on a certain day and specified street, sustained a described injury to her wrist and that a doctor had set it, and "will advise you later as to expense" did not state that "satisfaction therefor is claimed of such city," as required by Wisconsin St. 1910, §1339, and was insufficient. There is a very material difference between a casual notice in writing that an injury has been sustained by reason of a defective street and that expense has been or will be incurred and a notice which makes a claim that satisfaction is demanded. It was held not enough that such notice was given the city that its officers could by investigation have ascertained all the facts, since that is not the only purpose of the statute. The fact that the claim was drawn by the city engineer at the instance of the claimant's son did not constitute waiver by or estoppel of the city; such act not being in performance of any duty to the city.

NEWS OF THE SOCIETIES

CALENDAR

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland, Ohio.

Jan. 17-19—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chicago, Ill.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18—ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS. Annual meeting. Secretary, Miss C. B. Adams, 3317 Olive St., St. Louis.

Jan. 18—SIOUX CITY A. A. E. Joint meeting with the Iowa Engineering Society convention. Sioux City, Ia.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 19-20—INDIANA ENGINEERING SOCIETY. Annual meeting. Purdue University, Lafayette, Ind.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 20 — SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERING. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28—ARKANSAS CHAPTER, A. A. E. Little Rock, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 30-Feb. 1—NATIONAL CIVIC FEDERATION. 22d annual meeting. Hotel Astor, N. Y. C.

Feb. 4-11—ST. PAUL BUILDING EXCHANGE EXPOSITION. St. Paul, Minn.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention, Cleveland. Secretary, Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' Bldg., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; April. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

AMERICAN ROAD BUILDERS' ASSOCIATION

The Road Builders annual couvention and the Good Roads Show will be held in the Coliseum, Chicago, Jan. 17-20. The tentative program provides for a classification of subjects and papers by sessions including the following:

Session Devoted to Bituminous Roads

"Bituminous Foundations":—Hugh W. Skidmore, C. E., Chicago Paving Laboratory. "Selection of Bituminous Wearing Course":—S. M. Pinckney, Chief Engineer, Bureau of Highways, Borough of Manhattan, N. Y. C. "Utilization of Local Material for Mineral Aggregate":—Major W. A. Welch, Chief Engineer, Palisades Interstate Park Commission, New York. "Asphalt Specifications":—L. M. Law, Chief Chemist, New Orleans Refining Company. "Specifications of Mineral Aggregates"—Roy M. Green, Manager, Western Laboratories, Lincoln, Neb. Requirements in Specifications":—Bruce Aldrich, Toronto, Canada. "A Simple Graphic Method of Proportioning Sands for Sheet Asphalt Mixtures":—Prevost Hubbard, Chemical Engineer, The Asphalt Association, New York City.

Session Devoted to Portland Cement Concrete Roads

"The Selection of the Mineral Aggregate for a Portland Cement Concrete Road":—John H. Mullen, Chief Engineer, State Highway Department of Minnesota. "Design of Concrete Roads for Heavy Traffic":—W. D. Uhler, Chief Engineer, Pennsylvania State Highway Department. "Inspection and Control of Materials for Concrete Roads":—R. W. Crum, State Testing Engineer, Iowa State Highway Commission. "Importance of Surface Finish and Methods of Control':—H. E. Breed, Consulting Engineer, New York City. "Single Track Concrete Roads for the Average County":—P. C. McArdle, County Superintendent, Vermilion County, Danville, Ill. "Pavement Widths for Highways Serving Large Cities":— Edward N. Hines, Chairman, Board of County Road Commissioners, Wayne County, Detroit, Mich.

Session Devoted to Common Roads

"Common Roads":—T. J. Wasser, State Highway Engineer, Trenton, N. J. "A systematic Study of Gravels for Road Purposes":—Wallace F. Purrington, Chemist & Testing Engineer, New Hampshire State Highway Department.

Session Devoted to Highway Financing

"The Proposed Wisconsin Plan of Highway Finance":—A. R. Hirst, Chief Highway Engineer, Wisconsin Highway Commission. "The Minnesota Experience in Highway Financing":— C. M. Babcock, Commissioner of Highways, Minnesota Highway Department.

Session Devoted to Highway Traffic and Highway Transportation

"Truck Overloading, Its Relation to Road Construction and Maintenance":—J. G. McKay, Ph. D., Professor of Economics, University of Wisconsin.

Session Devoted to Highway Research

"Highway Research":—W. K. Hatt, Professor of Engineering, Purdue University; Director of Research, National Research Council. "The Illinois Experimental Road":—Clifford Older, Chief Highway Engineer, Department of Public Works, Illinois. "Highway Researches and what the Results Indicate":—A. T. Goldbeck, Chief, Testing Division, U. S. Bureau of Public Roads, Washington, D C. "The Highway Outlook"—Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, Washington, D. C. "Cost Keeping on Highway Construction":—A. R. Losh, Assistant Bureau of Construction, U. S. Bureau of Public Roads, Washington, D. C. "Development of Small Stream Valleys into Traffic Routes":—Jay Downer, Chief Engineer, Bronx Parkway Commission, New York. "Uniform Legislation as Affecting Highway Traffic and Highway Transport":—D. C. Fenner, Manager, Public Works Department, International Motor Co., New York City. "Construction and Maintenance of Earth Roads":—George E. Johnson, Secretary of Public Works, Lincoln, Nebraska. "Highway Construction on the Pacific Coast":—Herbert Nunn, State Highway Engineer, Salem, Aregon. "Cooperation of All Parties Interested in the Construction of a Modern Road":—William Ord, Manager, Paving Department, The Lakewood Engineering Co., Cleveland, O. "The Business End of a State Highway Department":—Charles M. Upham, State Highway Engineer, North Carolina State Highway Commission. "The Highway Contractor's Problems":—H. H. Wilson, Winston Brothers, Muncy, Pa.

(Continued on page 38)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

ASPHALT DISTRIBUTOR ESPECIALLY ADAPTED FOR ROAD WORK

ROAD BUILDERS' ETNYRE ASPHALT DISTRIBUTOR

E. D. Etnyre & Co., who for years have manufactured road oiling equipment, have developed and perfected a new model asphalt distributor, that will handle all grades of bituminous material, and is especially adapted for road building, as it will heat materials to their respective working temperatures, and will apply under pressure any desired amount up to three gallons per square yard. It can be used with equal efficiency for surface coating as well as for road oiling.

Machines will be furnished complete, as shown in the cut, with or without cab top, or the distributor only furnished for mounting on any make of truck. The distributor is a complete unit, built on its own frame, can be quickly applied and removed, so that the truck can be utilized for double service.

The 750 gallon tank, suitable for 3½ ton truck, is the standard, but any size can be supplied to correspond to the capacity of the truck for which it is intended.

Among the important features, which are special in this model are:

1. The tank is completely enveloped with asbestos for the purpose of conserving heat.

2. An auxiliary heater quickly melts any material that may solidify in the pump or discharge line, while machine is standing idle, and which also maintains the proper heat at these points while in operation.

3. Large capacity pump that will discharge 200 gallons of material per minute, 750 gallons in less than four minutes, that will clean the pipe line and nozzles by pumping air, will gll the tank from supply tank when below its own level, or can be used to transfer material from one tank to another.

The distributor consists of heavy steel tank, with seams welded, provided with manhole, overflow pipe and heating flues. The heat is supplied by non-carbonizing kerosene burners and is applied to the material in the tank through the flues and to the ends and lower half of the tank, giving very large heating surface. The flame, being directed through the flues, does not come in contact with the tank, which eliminates the daner of injuring the metal.

The pump is of the rotary gear type and driven by a 4-cylinder, vertical water cooled motor, through steel and rawhide gears. Motor is equipped with high tension magneto and disc clutch and is cooled by radiator circulation and fan. A noiseless flexible coupling is used between the engine and drive shaft.

The distributing line is made up of 2 4-ft. sections of 2-inch pipe, etch section being controlled independent of the other, equipped with nozzles spaced so as to give a double lap. Strainers, which can be quickly cleaned, placed in the line prevents nozzles from clogging. Spray bars are attached by unions, and can be easily removed. Pressure and temperature gauges are furnished with the distributor.

The manufacturers claim that in this model they have combined simplicity of design, substantial construction, light weight, ease of operation and that it will perform the work for which is it intended in a first class manner.

AN IMPROVED PAVER

Among the exhibits in paving equipment at the National Roads Show to be held in Chicago, January 16th to 20th, will be the 1022 model of the Rex Paver, manufactured by the Chain Belt Company. It has attracted considerable attention during the past year because of its enclosed type of transmission. The Chain Belt Company is the first to have made use of this type of transmission, so successful with motor trucks, on paving machines. The enclosed transmission is highly successful on paving mixers.

Another distinctive feature that will attract the attention of highway contractors is the enclosed power operated discharge of the Rex Paver. All gears operate in oil so that the manipulation of the discharge chute is not only very easy but also remarkably fast. The swinging of the chute responds almost instantly to the touch of the lever.

The Paver on exhibition will be equipped with the full length type of traction adapted to the three suspension principle. A new type of Rex Distributing bucket will also be shown.

The company also plans to exhibit a central mixing plant mixer with features that are a radical departure from the present mixer standards.

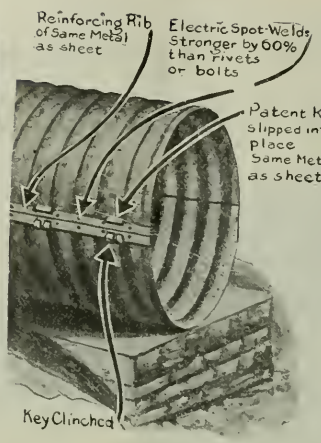
BUTT JOINT NESTABLE CULVERT

This culvert, for which the Floyd & Hubbard Co., Inc., are agents, is manufactured by the Chattanooga Road Machinery Co., and is made of nestable sections of corrugated sheets claimed to be 99.90 per cent. pure iron, and each square foot of exposed surface is coated with two ounces of spelter. Running along both longitudinal edges of the sections, and flush with them are flat bars of iron of the same quality metal as the culvert, which, where they come into contact with the convex points of the corrugations are electrically welded to the latter. When making up a culvert these units are simply placed edge to edge, one on top and one on the bottom and the two halves are held securely together by keys that slip behind the bars on the upper and lower sections.

These sections are of a standard length of approximately 2 feet, consequently a culvert of any desired length can be made up. All units are exactly alike, and there are no special top, bottom or end sections, no male or female joints, so no chance for a mistake in assembling. The galvanized keys are of the same material as the culvert and are die cut, assuring uniformity and absolute fit. The culvert is supplied in sizes from 8 to 96 inches in diameter full round, and also with flat bottoms.

Butt joint nestable culvert is claimed to be 50 per cent. stronger than riveted. The shell forms a perfect circle, with no overlapping longitudinal seams.

SECTIONS NESTED FOR STORAGE OR SHIPMENT


Reinforcing Rib of Same Metal as sheet
Electric Spot Welds Stronger by 60% than Rivets or bolts
Patent Key slipped into place Same Metal as sheet
Key Clinched

DETAIL OF ASSEMBLED JOINT

There are no bolts or rivets and no holes anywhere in the metal.

The flexible joint cannot be broken and permits the culvert to conform to the unevenness of the ground. It is perfectly tight, with no wide flange to interfere with tamping, and no bent flange to crack the galvanized surface. It has a double thickness of metal two inches wide every two feet. The culvert can be opened up at any point for cleaning. When nested, it occupies about 1/10 of the space riveted pipe does. Can be unloaded, hauled, assembled and installed by one man. Trucks are not necessary for hauling, the rear of a Ford touring car will hold 100 feet of 12-inch butt-joint nestable culvert.

(*Continued from page 36*)

IOWA ENGINEERING SOCIETY

Thirty-fourth annual meeting, Sioux City, Iowa, January 17-18-19-20, 1922. John H. Dunlap, president, Alvin Le Van, vice-president, Lloyd A. Canfield, Secretary, J. D. Wardle and Henry H. Dean, directors.

January 17, Afternoon: First session of the section on Drainage Engineering Assessments of benefits in drainage districts in which are included one or more existing districts: Tile districts, Ben H. Lamb, Spirit Lake, Iowa, County Drainage Engineer; discussion. Open ditch districts, Seth Dean, Glenwood, Civil Engineer; discussion. The differences in the principles to be used in making benefit assessments in flood protection districts and in drainage districts, C. H. Young, Mucatine, Iowa, President, Central States Engineering Co.; discussion.

Evening: Second session of the section on drainage engineering. Sub-soil of a factor in drainage design, Prof. G. R. B. Elliott, St. Paul, Minn., University Farm; discussion. Recent amendments to the drainage law and recent court decisions of interest to Drainage engineers, Judge John W. Anderson, Sioux City, Iowa; discussion. Aerial photography as used in drainage surveys, J. H. Mayne, Council Bluffs, Iowa; general discussion.

January 18: Address of welcome, T. H. Johnson, Sioux City, Iowa, Consulting Municipal Engineer, President Engineer's Club of Sioux City. President's address, John H. Dunlap, Iowa City, Iowa, Prof. of Hydraulics and Sanitary Eng., State University of Iowa. The business outlook for 1922, H. C. Baldwin, Wellesley Hills, Mass., Member of Babson's Statistical Organization. Afternoon: Simultaneous meetings of all sections.

Drainage Section: The drainage engineer's compensation, Edward B. Tourtellot, Oelwein, Iowa, City Engineer; discussion. Report of committee on standard specifications for drainage construction—three subcommittees: Open ditches, C. Moriarty, Sioux City, Iowa. Tile drainage, J. L. Parsons, Fort Dodge, Iowa, County Engineer. Leeves and pumping plants, H. C. Beckman, Muscatine, Iowa; business meeting.

Highway Section: Design and specifications for 1922 bridge construction, J. H. Ames, Ames, Iowa, Bridge Engineer, Iowa Highway Commission. Testing pavements and pavement materials, R. W. Crum, Ames, Iowa, Engineer of Materials and Tests, Iowa Highway Commission. Daily progress record with various types of equipment on pavement in 1921, H. K. Davis, Ames, Iowa, Chief Inspector, Iowa Highway Commission. Gravel road construction, J. F. Reynolds, Storm Lake, Iowa, District Engineer, Iowa Highway Commisssion. Gravel road maintenance, A. H. Cunningham, Storm Lake, Iowa, County Engineer, Buena Vista County. Election of officers and appointment of committees.

Mechanical Electrical Section: The proper distribution of power costs, Chas. F. Schoonmaker, Cedar Rapids, Iowa, Chief Engineer, Quaker Oats Company; Superheating in steam power plants, R. M. Ostermann, Chicago, Ill., Vice Pres. Superheater Co. The function of the state railroad commisssion in electrical transmission line development in Iowa, A. B. Campbell, Des Moines, Iowa, Electrical Engineer for Iowa Railroad Commission. Election of officers and appointment of committees.

Municipal Section: History of sewage disposal in Iowa, Chas. P. Chase, Clinton, Iowa, President, Iowa Engineering Company. Disposal of municipal refuse, Rolland S. Wallis, Ames, Iowa, Eng. Ext. Dept, Iowa State College. Disposal of packing house waste by the activated sludge process at Mason City, Iowa, Edward Bartow, Iowa City, Iowa, Head of Dept of Chem., State Univ. of Iowa. Round Table Discussion: Size of sewer house connection, minimum sewer grades, newer types of pavements, election of officers and appointment of committees.

Railroad Section: Reminiscences of the early days of railroad building in the State of Iowa, James Carss, Des Moines, Iowa, Concrete Inspector, City of Des Moines. Relation of the engineer to railroad operation, R. J. Smith, Davenport, Iowa. Fireproofing of wooden bridges, Eng. of Way and Structures, U. L. & Ry. Co., E. M. Lewis, Des Moines, Iowa, Eng. of Maintenance of Way, C. G. W. Ry. Organization of officers. Election of officers and appointment of committees.

Structural Architectural Section: Measuring public fire protection, Harry J. Corcoran, Des Moines, Iowa, Chief. Eng. Iowa Insurance Service Bureau. Building code problems, Paul E. Wylie, Des Moines, Iowa. Results of recent investigations in concrete, Duff Abrams, Chicago, Ill., Prof. in Charge of Structural Materials Research Laboratory, Lewis Institute. Organization of permanent section. Election of officers and appointment of committees.

Evening: Fifth annual camp fire. This session will be a joint meeting of the Iowa Engineering Society and the business men of Sioux City. The evening will be devoted to short talks by prominent engineers and business men and special entertainment.

January 19, Morning: Business meeting, regular business and officers' reports. Report of standing committee on legislation. Report of special committee on professional practices. Report of special committee on construction costs.

Afternoon: The financial problem of the railroads, C. D. Cass, Waterloo, Iowa, Gen. Mgr., Waterloo, C. F. & N. Ry. Research at the new hydraulic laboraat the State University, S. M. Woodward, Iowa City, Iowa, Head of Dept. of Hydraulics and Mechanics, State Univ. of Iowa. Report of special committee on standard contracts, services and fees.

Evening: Informal banquet and dance.

January 20: Community development and the engineer, William Holden, Sioux City, Iowa, Gen. Sec., Chamber of Commerce. Inspection trips: Visiting representative industries and the engineering features of the city.

KANSAS ENGINEERING SOCIETY

At the meeting of the Kansas Engineering Society on December 22nd and 23rd, the following officers were elected: president, Lloyd B. Smith; vice-president, P. L. Brockway; secretary-treasurer, J. M. Averill; and directors P. J. Ruckel and H. B. Walker.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 NEW YORK, JANUARY 21, 1922 No. 3

Sewage Treatment in Imhoff Tanks

By Russell Riker *

Separate digestion of sewage sludge in two-story or Imhoff tanks. Experiences with thirty-seven such tanks in New Jersey, and conclusions of the State Department of Health as to certain advantages and disadvantages of such tanks.

NOTE: Most of the information and data contained herein are derived from small plants such as the New Jersey municipalities construct.

In New Jersey there are (1921) thirty-seven Imhoff installations serving thirty-three municipalities, five institutions and three corporations. Large installations of two-story tanks have been constructed in the following cities: Albany, Rochester, Worcester, Atlanta, Baltimore, Columbus, and Schenectady. Table No. 1 shows the rapid growth in population served by this type of tank in the State from 1913 to 1922. The considerable increase between 1917 and 1918 is due to the construction of the Plainfield sewage tank, which is at present the largest installation in this state.

This table also gives a comparison between the number of one-story and two-story tanks constructed in New Jersey since 1911. The ten army one-story tanks constructed in 1918 have not been included. The alarming factor in this comparison is the great increase in the two-story tank during the last few years as compared with those figures of the one-story tank.

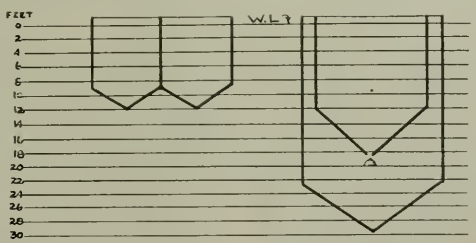
The two-story tanks are costly to construct, due principally to their necessary greater depths. Then there is an added cost due to the royalty fee based upon population to be served and ranging in amount from $10 for one hundred population to $15,000 for two million population. Municipalities are particularly interested in the cost, both initial and operating, as they gain no direct revenue from treatment plants. The state is interested in the degree of purification secured in the operation of the plant.

The operating expense also is high. At Plainfield, where the sprinkling filters follow tank treatment, it is estimated that two-thirds of the total operating cost is expended on the Imhoff tanks. Here the total cost in 1919 for the Imhoff tank was $6,699.38, or $5.50 per million gallons of sewage. The estimated cost of operation for the smaller plants ranges from $2.00 to $15.00 per million gallons of sewage, averaging about $5.00 per million gallons.

Recently an engineer, who had just returned from Germany, stated that the construction of Imhoff tanks in that country had about ceased due to the unsatisfactory results obtained in operation and that several municipalities were being sued because of nuisances

Table No. 1—Population Served by Imhoff Tanks and Number of Tanks in New Jersey, 1911 to 1921

Year	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
Population	7,000	9,000	12,500	36,000	41,000	44,000	52,000	84,000	91,000	100,000	104,000
Number of Imhoff tanks.	1	2	6	12	15	18	23	24	26	34	37
No. of single-story tanks.	8	12	17	23	32	35	40	42	43	44	45



COMPARATIVE EXCAVATION DEPTHS OF SINGLE-STORY AND IMHOFF TANKS WITH EQUAL SETTLING CAPACITY

*Assistant Sanitary Engineer, Dept. of Health of New Jersey.

due to odors. He further stated that separate sludge digestion of sewage was still being followed in Germany, but that it was carried out by other means than Imhoff tanks.

The first Imhoff tank in New Jersey and one of the first in the country was constructed at Chatham in 1911. This installation of 300,000 gallons capacity serves jointly the municipalities of Chatham and Madison. Dr. Imhoff was in this country at this time and personally inspected and approved the plans and construction of the tanks. It is interesting to note that they were designed with a tight concrete cover, indicating that Dr. Imhoff was of the impression that it would not be necessary to remove scum from the surfaces of the tanks and this impression is still left with the officials of the municipalities by many consulting engineers. For nearly a year it was impossible to watch the action in the tank at Chatham, but evidence of the foam and sludge having worked itself into and over the gas vents could be seen when the concrete cover was removed, which was necessary when the effluent became so charged with suspended solids as to interfere with the satisfactory operation of the plant.

FOAMING

Foaming is the basis of poor operating results. It may cause floating sludge and scum to overflow the top of the gas vents into the settling compartment, or it may fill the gas transition chamber or the gas vents with foam and floating sludge so as to force such material up through the slot from beneath. This phenomenon has been described in numerous engineering journals. The best practical comments can be found in the engineering journals under articles upon the operation, by the operators of the plants at Fitchburg, Atlanta, Columbus and Schenectady.

Our experience leads us to agree with the opinion of the Columbus operator, that the same bacteriological action occurs both in the one-story and two-story tank. In this state practically every single-story tank in operation has from one to six feet of scum on the surface with very little sludge in the bottom and the top level of scum is always several inches higher than the water line. The small gas vents of the two-story tank makes the ebbullition of gas and sludge more pronounced, however, than in the one-story tank,

The theoretical cause of foaming, as advanced by chemists, bacteriologists and sanitary engineers, is the predominance of the ordinary bacterial decomposition over enzyme action or liquefaction. Ordinary bacterial decomposition results in the production of excessive sulphurous gases which are not entirely absorbed by the surrounding liquid. How to secure a proper balance between enzyme liquefaction and bacterial decomposition, with a predominance of the former, has never been discovered. Foaming occurs in all types of two-story tanks and it may occur with all or any character of sewage, although it has been found less noticeable with stale sewage.

Table No. 2—Data on Design of the Largest Imhoff Tanks in the United States

Municipality	Capacity, million gals. per day	Total Depth, in feet	Percentage Area of Gas Vents to Settling Area	Detention Period, hours	Sludge Storage, cu. ft. per capita	Slot Size, inches	Sludge Bed Area, sq. ft. per capita
Albany	30	27	4.75	3	1.7	8	.44
Atlanta							
Plant No. 1	3	25	4	3	1.7	6	.39
Plant No. 2	5		8				
Plant No. 3	8		8				
Baltimore	14	26	18	2	1.0	8	.5
Columbus	35	27	9	1.7	1.2	8	.38
Rochester							
Plant No. 1	55	40	34	1.5	2.0	6	.33
Plant No. 2	2	23	12	2.5	1.84	6	.33
Schenectady	8	21	20	1.5	0.75	6	

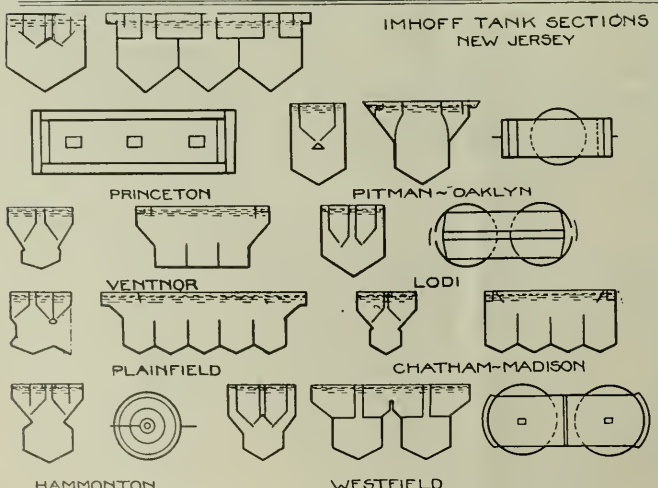


FIG. 1.—SECTIONS OF PRINCIPAL IMHOFF TANKS IN NEW JERSEY

DESIGNS OF IMHOFF TANKS

Table No. 2 gives a list of the larger Imhoff tanks constructed in this country, with the unit size for which the tanks were designed. The depth ranges from 21 feet to 40 feet, the gas vent area from less than 5% to 34%, the detention period from one-half to three hours, the sludge storage capacity from .75 cubic foot per capita to 2.0, the sludge bed area from 0.3 to 0.5 square

foot per capita. The dimensions of these tanks were obtained from various periodicals.

Table No. 3 indicates the unit sizes used in the design of two-story tanks in New Jersey. These are small installations treating characteristic domestic sewage with the exception of a few which treat a small percentage of trade wastes. This list does not include all the two-story tanks but only those which have been given sufficient operating attention to determine with what degree of success they are working.

sewage at the treatment plant. Its specific gravity is so much lower than the water that when it is mixed with other organic matter it tends to cause it to float. Much of the objectionable odors at sewage treatment plants are caused by the nauseating odor of grease, digestion of which is difficult. It is a common occurrence to discharge good digested sludge from a settling tank with patches of grease balls. The sludge will have practically no odor until the grease balls appear and then the odor is very objectionable. Grease traps installed as one of the units

Table No. 3—Imhoff Tank Unit Dimensions, New Jersey Tanks

Municipality	No. of tanks	Capacity designed for, gallons per day	Inside dimensions, feet, L. W. D.	Percentage area of gas vents to settling area	Size of slot	Sludge Capacity cu. ft. per capita	Detention period, hours	Operation begun	Sludge beds, Floating scum per capita	sq.ft. depth	Per cent. of Sewage Sludge pipe size	Domestic
Chatham-Madison	2	340,000	50 x 14 x 12	5.4	6″	1.3	2	1911	.6	5′	8″	100
Fairview	2	400,000	30 Diam. x 18	10	6″	1.0	2.8	1915	.62	..	..	90
Hammonton	1	250,000	33 Diam. x 27	4.5	9″	.75	2.75	1915	..	11′	8″	80
Lodi	3	500,000	60 x 25 x 30	10	6″	1.8	1.5	1920	0.25	14′	8″	80
Oaklyn	1	168,000	30 x 12 x 24	10	6″	1.1	2	1917	.35	8′	8″	100
Pitman No. 1	1	300,000	40 x 21 x 22	26	6″	1.5	2.5	1917	.2	7′	8″	100
Pitman No. 2	1	100,000	30 x 12 x 24	10	6″	1.9	2	1918	..	10′	8″	60
Plainfield	6	3,000,000	65 x 35 x 20	13	6″	1.2	1.5	1916	..	..	..	90
Princeton	1	300,000	54 x 28 x 20	48	6″	1	2.5	1914	1	9′	..	100
River Edge	1	75,000	25 Diam. x 17	4	10″	1	2.5	1918	1	5′	8″	100
Roebling	1	350,000	50 x 25 x 21	10	8″	1.5	2.5	1921	1.0	8.5′	6″	100
Skillman	1	300,000	43 x 22 x 16	40	..	..	2	1919	.8	7′	8″	100
Ventnor	3	600,000	41 x 18 x 22	13	6″	1.5	4	1916	.16	13′	6″	100
Washington	1	200,000	40 x 14 x 23	44	6″	1.0	2	1919	1.4	7′	6″	80
Westfield	1	600,000	70 x 35 x 26	6	6″	.7	2	1915	0.3	16′	8″	90

Fig. No. 1 gives the sectional views of the principal Imhoff tanks in the state.

Screens: Coarse screens were advised by Dr. Imhoff and were installed at the Chatham-Madison plant, but the superintendent has since removed the screens and advises against installing them. It may be that with the character of the sewage at the Chatham-Madison plant screens are not necessary, but it is though advisable to install screens previous to Imhoff tanks provided these screens will be well taken care of. Screens neglected usually cause a nuisance and are better left out unless there is an attendant at the plant who can be relied upon to clean them frequently. One of the simplest and best operating screens is the type installed at Freehold which is similar to that at Baltimore, Md. The screen is placed at an angle parallel to the line of flow and not perpendicular as is usually the cause. Fine screens of the Reinsch-Wurl type have been installed at Plainfield previous to Imhoff tank treatment and the operator claims that they assist in the operation of the plant.

Grit Chambers: A grit chamber should be installed previous to tank treatment, principally to remove the foreign mineral solids which are found even in a separate system. The material, especially sand, should not be allowed to enter the tank, as it fills the hopper bottoms of the sludge digestion chamber and makes impossible the drawing of the sludge.

Grease Traps: Although grease interferes with the proper digestion of sewage sludge more than any other constitutent, no satisfactory grease trap has been designed to remove it from the domestic

at the sewage treatment plants for army cantonments during 1917 and 1918 were failures. In the army traps when the grease did come to the top, the putrescible organic matter would settle to the bottom and become septic, later rising to the top and mixing with the grease. This happened particularly during the time of minimum flow. The army solved the grease problem by installing grease traps on the kitchen drain of each mess hall so as to prevent the grease from mixing with the toilet wastes. To aid in the treatment of sewage it is suggested that whenever possible grease traps be installed on the kitchen drains from hotels, hospitals and institutions.

Pumps: Pumping the sewage has somewhat the same effect on the suspended matter as fine screens. Breaking it up assists considerably in the digestion of the suspended matter.

Inside Dimensions: The width of the tanks designed in New Jersey ranges from 12 to 35 feet, the length from 30 to 70 feet and the depth from 12 to 30 feet; an average ratio of width to length of 1 to 2. This ration can be made larger but if the length is made longer care must be taken that the cross-section of the settling tank be such as to keep down the velocity of the sewage. Dr. Imhoff recommends that the tank be as deep as possible, explaining that the fresh sewage mixes better with the digested sludge and thus gives a greater rapidity of decomposition. Experience in New Jersey does not indicate that the advantages in operation gained by building deep tanks warrants the increased cost of construction. No doubt there is a greater rapidity of gas ebullition in the deep tanks,

resulting in better agitation, but there is no indication that the deeper tanks, all other conditions being the same, are working better in this state than the shallow ones.

Type of Tank: Imhoff tanks may be of four types; longitudinal horizontal; radial horizontal; downward and upward and radial horizontal flow. Of these, the longitudinal horizontal is the most common. It is easier to construct and gives as good efficiency as the others.

Number of Tanks: If the flow is greater than one-half million gallons per twenty-four hours, more than one tank is usually constructed. Experience would indicate that it is better to have two tanks, even if the flow is less than one-half million gallons per day, so that if trouble, such as foaming, is encountered with one tank it can be shut off and allowed to rest for a short period.

Inlets and Outlets: The practice of reversing the direction of flow in Imhoff tanks makes it necessary that separate inlets and outlets be constructed at each end, or that a weir be constructed at each end to act as both inlet and outlet. In the latter case both weirs must be at the same elevation and great care must be taken to design the channels so as to give proper velocity during the minimum period of sewage flow, in order to prevent sedimentation in the influent channels. In either design care must be taken to distribute the flow equally to each tank. The proper distribution of solids, as well as the quantity of sewage, is also very important for in some cases one tank has been known to take more of the floating material and larger solids, resulting in a poor sludge digestion. Interesting experiments carried on at Plainfield by the operator, John R. Downes, and Prof. Earl B. Phelps, indicate that with three tanks in operation the tank farthest away from where the sewage entered received by far the greatest quantity of sewage.

Operators are more favorably disposed toward separate inlets and outlets. In fact, in some instances separate inlets have been constructed after the plants were placed in operation. Of the larger plants outside of the state, Schenectady has recently placed separate inlets which will allow the sewage to enter the settling chamber just beneath the channels. The effluent weir should be so designed as to increase the velocity as little as possible.

To be continued

River and Harbor Appropriations

Major General Beach, chief of the army engineers, in his annual report recommends the expenditure during the next fiscal year of approximately $11,000,000 for rivers and harbors in 11 southern states, exclusive of $7,500,000 for the Muscle Shoals project in the Tennessee river and $6,670,000 for the Mississippi river commission flood control. The aggregate amounts to about one-fourth of the sum recommended for the entire country. The harbor projects call for $1,025,000 for Savannah and for sums varying from $48,500 to $588,000 for nine other ports. For the southwest pass of the Mississippi river $1,136,000, and four other waterway projects appropriations of from $100,000 to $400,000.

Ornamenting an Intra-Mural Creek

A creek flowing through Hutchinson, Kan., is confined between retaining walls that are provided with boxes in which are grown vines that cover the wall. An overflow channel has been carried around the city to protect it from floods.

Like many other cities, Hutchinson, Kansas, lies on both sides of a stream which, flowing through its business center, as well as the residence section, offers several difficulties in the way of street location and construction. In addition to this, as is generally the case, it was found almost impossible to prevent the use of the banks and the stream itself for deposits of all kinds of rubbish. In addition to the matter of appearance and interference with street location the creek occasionally, in times of floods, overflows its banks and floods buildings adjacent to it.

In order to remedy these conditions the city excavated a canal around its southern border connecting with the creek at the two extremities of the town and placed flood gates in the canal so that, in times of high water, the surplus flood could be carried around the town through the canal. The portion of the canal passing through the town was confined between two

FLOWER BOXES ARE PLACED JUST ABOVE THE WATER LEVEL AT EVERY THIRD POST
Some of the vines have started growing.

WHERE THE CREEK PASSES UNDER THE CONVENTION HALL
Parts of the wall and fence at the extreme right are seen to be covered by the vines.

concrete walls, the walls and the grading behind them being carried up to street level. Along some parts of the creek a street separates it from the buildings, while in other cases the creek passes along the rear of or under buildings, some of which use the wall as a part of their foundations. In the business center of the town the creek has been entirely covered over, passing under streets and buildings entirely out of sight.

A unique feature of this wall is that there were constructed along it flower boxes, cast integral with the wall and located just above water level. In these boxes have been planted vines with a view to having them gradually cover the wall to a large extent and relieve the monotonous appearance of the concrete surface. Already the vines have taken a good start, and add greatly to the appearance of the waterway.

Piping Streets Before Paving

The problem of deciding to what extent water, gas and sewer mains, and house connections made with them, should be constructed in a street before paving is done on it was discussed at length before the twenty-third convention of the League of California Municipalities. The discussion was opened by J. A. Griffin, city engineer of Los Angeles, who stated that the first judgment of any engineer would probably be that all pipes should be laid before paving. He referred to the practice which he understood obtained in certain eastern cities of refusing permission to cut into a pavement for ten years after it was laid, which, he stated, would be entirely out of the question in the case of a city growing as rapidly as Los Angeles, where it is almost impossible to keep up with the immediate demands for mains and connections without thinking of anticipating future needs. During the nine months previous to the convention 30,241 trenches had been cut in the streets of Los Angeles, and 90 men with 7 trucks and 11 road rollers found it impossible to put back the trenches as fast as they were cut, and Mr. Griffin stated that he was running behind at the rate of 60 trenches a day.

This, however, is not an argument against a pre-construction of mains and connections in ordinary cases. More important is the fact that, in a new city or one growing as rapidly as Los Angeles, it is impossible for engineer, city planner or any one to foresee ten years in advance just what the development will be, what direction it will take and what size of main or sewer will be required for that particular street.

Perhaps even more important an argument against pre-construction is the large amount of capital that is tied up. Some water or gas companies, if required to extend their mains sufficient to cover ten years' future growth, would find this making such a drain upon their capital that they would almost have to go out of business, while the interest on the non-productive capital thus buried in the ground would be sufficient to pay a fair dividend to the stockholders or would add considerable to the rates which the company must charge its customers.

If the company or city requires the property owner to pay for the house connection, holders of undeveloped property are burdened with a cost which may, in some cases, ruin the real estate investor or require him to sell the property at a loss. Mr. Griffin did believe, however, that the company or owner should be required to put in all pipes or connections required for two years or so in advance, believing that it would be possible to visualize that far ahead.

Another matter that was brought up in the discussion was the fact that the blind-end or dead-end connections were very apt to rust out by standing idle. Mr. Monroe, of San Diego, stated that in that city such services rusted out in nine months in some cases, while in other parts of the city they would stand for 15 or 20 years.

Marston Campbell, of Oakland, stated that some years ago he put in two miles of sewers in Honolulu and ran connections 25 feet each way to the property lines in front of all lots that were not built up. "Today not one in ten of these connections are used, and that street is entirely built up. In other words, we put thousands of dollars of work under the ground that is absolutely useless today because no one can tell just where the laterals will be required until the property is built up."

As to the matter of cost, Mr. Stranahan, of Fresno, stated that he had arranged that the water company should be notified of proposed paving as soon as the resolution for the work had been passed, because neither a city nor a water company can, in a few minutes, plan the mains most suitable for a given street or obtain the money or material for constructing them. In many cases there is no difficulty in showing the company that it would be cheaper and better for them to lay the mains before paving, for since they are required to pay all expenses of repaving any paved street which they have cut into they will find themselves economically justified in putting in pipe lines and connections in advance of the pavement.

Most of the speakers seemed to agree that it was impossible to prevent companies or municipal departments from opening up pavements for laying sewers and water mains, although it is possible to limit this by planning sufficiently far ahead and notifying the companies or departments concerned.

There seemed to be general agreement that the best solution of the problem was to provide alleys in all parts of the cities and require the underground mains to be laid in these alleys. In Fresno new subdivisions are required to have alleys for public utilities, and the same is true of Fullerton.

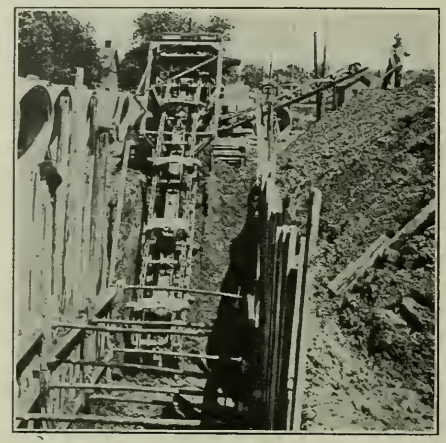
Mulcting the Water Department

The Cincinnati council passed an ordinance recently authorizing the transferring, at the end of each month, of the surplus funds of the Water Department to the general fund of the city. It is proposed to increase the water rates and use the department as a source of public profit.

There is, however, question as to the right of the city to use the revenues of the department for other than departmental purposes, and Mayor Carrel has announced that about the middle of February a suit would be filed to settle this point.

Two-Cut Machine Trench Excavation

A deep trench of a greater width than that of the available excavating machine was recently dug at Muncie, Ind., where the machine was operated twice, each time making a maximum width cut of 54 inches to the depth, also maximum, of 20 feet and thus securing a trench 108 inches wide that was sheeted with vertical boards as the work progressed. The vertical boards were braced by adjustable screw braces that engaged two or more tiers of waling pieces.



EXCAVATING TRENCH WITH TWO SUCCESSIVE CUTS

The spoil was deposited by the machine on one side of the trench while the precast concrete pipe to be laid in the trench was delivered on the opposite side without interfering with continuous operations. The trench was excavated at the rate of 266 linear feet per 10-hour day, handling the earth at the rate of 80 cubic feet per minute and at a cost of 5.2 cents per cubic foot. The work was done by the Harris-Andrews-Henderson Co., Youngstown, Ohio, with an Austin trenching machine operated by a 100-h.p. gasoline engine.

Building Concrete Pier on Hard Rock Bottom

In the construction of a reinforced concrete pile pier in an exposed position where the water had a minimum depth of 23 feet at Manila, P. I., holes 2 inches in diameter at the bottom were drilled 13 feet into hard volcanic rock and enlarged by blasting to receive precast piles 18 inches in diameter.

The piles were braced above water level by reinforced horizontal and diagonal struts cast in place with their reinforcement rods clamped to the piles and the connections thoroughly protected by concrete jackets with reinforcements secured by the pile clamps. The drill bits were protected by pipe casings inserted 18 inches into the rock in holes made by expansion bits operated inside the casings. The pier was designed to resist heavy wave action and the reinforcement steel was thoroughly protected with extra thick rich concrete.

New London Turnpike II*

Quarries, sand pits, distribution of cement and aggregate by trucks and industrial railroad, moveable storage bins, pumping, concrete mixing, finishing and curing equipment.

About 8,000 yards of broken stone required for the concrete in the northern four miles of contract one were shipped from Hartford in railroad cars, run over trolley tracks to the freight yards in Glastonbury, where it was unloaded to storage by the Brownhoist locomotive cranes. The remainder of the 16,000 yards of 1½-inch broken stone, the larger stone required for Telford foundation and a small aomunt used for drains or culverts, walls and miscellaneous purposes was local stone, quarried by the contractor at Marlboro or gathered near the road alignment. Where satisfactory material was found desirably located, the property was purchased or leased and the rock taken out, crushed and transported to the general storage bins and piles at an average total cost of about $4.00 per yard.

There were two quarries, one at Marlborough Four Corners near the south end of contract No. 1 and one at New London, the south end of contract No. 4.

The Marlborough quarry was a hillside ledge of trap rock with an approximately level floor at grade and a face 150 feet long and from 40 feet to 60 feet high, from which the rock was easily thrown down by drilling and blasting. It was handled with scale boxes and with chains to the Farrel crusher, and broken to 2½ inches at the rate of about 100 tons per day, elevated by a bucket conveyor to a cylindrical screen about 30 feet above the ground, mounted over a 35-yard storage bin, from which the

*Part 1—General description grading, unloading and storing aggregate and cost of handling broken stone was published in the January 14th issue.

CRUSHER AND BINS AT MARLBORO QUARRY

CRUSHING AND SCREENING PLANT AT NEW LONDON QUARRY

broken stone was delivered through three vertical sliding steel gates and spouts to automobile trucks.

This quarry was operated to keep the 35-yard storage bin filled and was run steadily for about five months with an average force of 18 men turning out a total product of about 8,500 yards, which could have been greatly increased if convenient storage had been larger or if the consumption had warranted it.

The New London quarry, opened in 1920, before beginning road construction, has furnished this year more than 16,000 yards of granite, produced by an average working force of 15 men. It was opened with a circular pit about 40 feet in diameter and 15 feet deep, and has been worked on all faces extending the excavation to correspond roughly with the area commanded by the 80-foot boom of a guyed derrick, which serves it and delivers the rock in scale pans to the 13x14-inch Farrel crusher.

The present shape of the quarry pit is roughly a crescent in plan, extending about 200 degrees around one side of the derrick mast and having concave sides worked back farther than the convex side from the original pit, beyond the radius of the boom, permitting a greater quantity of rock to be thrown down from it, within easy reach of the derrick. The drilling is done with three Ingersoll-Rand drills and the product of the crusher is delivered to the Good Roads elevator, discharging through a circular screen on top of the 50-yard hopper-bottom bin, from which the product is spouted to industrial cars or trucks.

A small amount of rejects from the crushers are returned and broken to 2½ inches, except a small amount that are reserved for Telford foundation and for culverts and drains. The stone dust, amounting to about 25 yards per day, is used on the road shoulders.

When the work was most active the cars operated to their fullest capacity with a total force of about 60 men working from 10 to 16 hours per day who produced a maximum quantity of 250 tons per day, thus enabling the quarry to produce within 2,000 yards of all the stone required for the south end contracts 3 and 4.

SAND PITS

About 4,000 yards of sand required for the first four miles at the northern end of contract No. 1 was imported, and about 7,000 yards used at the south end of contract 4 was also imported and delivered by water at New London. The remainder of the 30,000 yards of sand required for the entire work was produced locally by the contractor in several pits at different points along the work, so that in

½-YARD CLAM-SHELL BUCKET EXCAVATING SAND FROM OLD RAILROAD BORROW PIT AT COLCHESTER

some cases the haul on sand amounted to 12 miles in each direction. Hauling was done with 5-ton automobile trucks delivering the sand to storage in advance of the road construction. The principal pits were at Marlborough and Colchester. The former was operated by a derrick and clam shovel. The clean, sharp sand, which did not require washing or screening, was hauled by trucks at an average rate of about 200 yards per day. A force of only 2 teams and 5 men was required at this pit and the total output from it was about 4,000 yards.

The most important pit was that at Colchester, which supplied about 16,000 yards of sand for con-

SAND-WASHING PLANT AND LOADING BIN. DERRICK COMMANDS SAND PIT

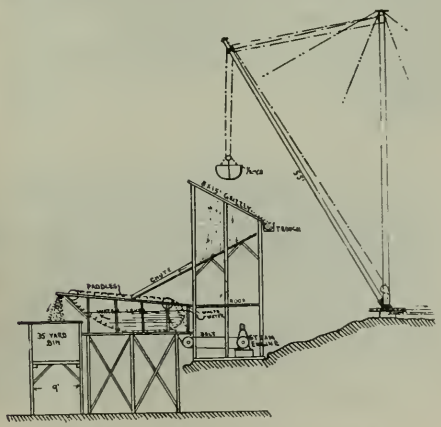


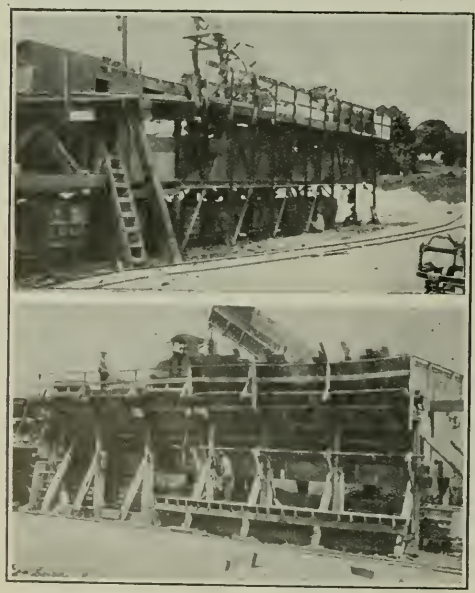
DIAGRAM OF SAND-WASHING PLANT

tracts 3 and 4, covering most of the south end of the turnpike. The pit was located near Colchester at about the middle of the 16 miles of road that was served by it. The sand was excavated by a 1-yard clamshell bucket, operated by the 70-foot boom of a guyed derrick. As soon as the sides of the excavation receded from the reach of the boom, the sand was washed down a natural slope by a hydraulic jet provided with water pumped from a creek about 2,000 feet away and delivered under 125 pounds pressure through a 2-inch nozzle, the pumping being done by a duplex pump furnished with steam from a 50-h.p. boiler.

The clamshell bucket dumped the sand on a grizzly, elevated about 40 feet above the surface of the ground, where it was washed with four streams of water at about 50 pounds pressure through nozzles made by flattening 2-inch pipes. The rejects passed down the inclined surface of the screen to a wooden chute that distributed them to a waste pile. The fine material passing through the screen was carried by the waste water to an inclined trough lined with sheet iron that delivered it at the center of the 4x-foot wash box 18 feet long, made by the Good Roads Machinery Co. The box contains a pair of parallel full-length endless chains that are provided with transverse wooden cleats or paddles, corresponding to the buckets of an elevator. The lower parts of the chains travel below water level, following the horizontal bottom of the box part way and rising at the farther end over an incline upon which the paddles force a continuous stream of the coarser particles of washed sand and push them over the elevated lip of the box, whence they are discharged into the loading hopper. The agitation of the stream of water supplied to the washing box thoroughly cleaned the sand and floated off the dirt and smaller particles which escaped through the overflow at the rear of the box, the height of the overflow being regulated to determine the amount and fineness of the sand that it saved. The overflow gate is of a special type furnished by the manufacturers of the machine and regulated by a hand wheel.

The sand washing machine is installed in a wooden tower about 30 feet long and 7 feet wide, made with 10x10-inch vertical posts with sides, floor and roof of 2-inch planks. The paddles in the washing box are driven by a sprocket chain, operated by a belt from a 10-h.p. steam engine. The derrick is operated by a two-drum Lidgerwood hoisting engine; the wash water and the hydraulic jet water are furnished by a 14x8x13-inch Cameron pump with 5-inch suction and discharge pipes. The large amount of water carried over from the wash box with the sand makes it necessary to have an exceptionally tight hopper bin from which the sand is chuted directly to trucks. The plant is operated with an average force of about 7 men, and although run at only about one half capacity, produces from 400 to 500 yards per day. Some of the sand from pockets in this pit was naturally of proper size and did not require washing or screening. About 10,000 yards have been washed in the season of 1921 when a total of 50,000 yards were excavated and used for the roadwork. The cost of producing sand and storing it in hopper bins varied from about $3.00 to $3.50 per yard, according to whether it was washed or not.

(To be continued)



8 x 6 x 50 FOOT PORTABLE STEEL STONE BIN
WOODEN SAND STORAGE BIN AT COLCHESTER

Rapid Removal of Asphalt Pavement

The Pacific Telephone and Telegraph Co., Seattle, are now constructing a toll line project involving 25 miles of solid rock hole drilling that is being done by three men with jackhammers, operated by an Imperial portable air compressor, which also furnished air to operate the Ingersoll-Rand paving breakers, with which portions of the asphalt pavement on concrete base are removed at a cost of 9 cents per square foot, as compared with a cost of 28 cents per square foot when the work is done by hand.

The hand work is thus more than two and one-half times as expensive as the machine work, to say nothing of the additional saving of the cost of temporary planking that is used to cover the cuts made by hand work and is eliminated by the machine work, which removes the asphalt in large slabs that are temporarily replaced in the cut.

Three men with two pavement breakers will average 300 linear feet of asphalt pavement cut in one day against 80 linear feet cut by hand with a crew of eight men in one eight-hour day, the asphalt averaging from 3 to 6 inches thick and the concrete 6 inches thick.

The paving breakers are of rugged and durable construction, in which screw joints are eliminated and the shock is largely absorbed by springs. They use 1⅛-inch solid hexagon steels with chisel edges for cutting asphalt and a moil point for breaking or spalling the concrete or breaking frozen ground. The breakers weigh 58 and 68 pounds and are used with air pressures of more or less than 80 pounds respectively.

The Imperial type No. 14 portable compressor, which will operate two of the paving breakers, is of the vertical duplex water-cooled type, driven by electricity

or gasoline, mounted on a steel frame with broad tread steel wheels.

The outline of the section of pavement to be removed is laid out and "marked" by cutting holes 3 or 4 inches apart through the full thickness of the asphalt with the chisel edge of the breaker, thus practically enclosing the section of pavement with a groove. Transverse lines about 12 inches apart are laid out across the section and similar cuts are made in them, detaching rectangular pieces of asphalt about one foot in width, which are removed by hand, after which the chisel point is replaced by the moil point, and the latter is driven into the concrete in the center of the space, spalling off an irregular V-shaped section, the edges of which are broken off about 3 inches at a time on each side and the concrete removed in small pieces. The earth is loosened, if necessary, by the moil point, and the hole is excavated to the required depth.

Link in Bankhead Highway Completed

By R. V. Glenn *

Special integral concrete curb. Sliding dowels in expansion joints. Stone cars unloaded by tilting hoppers.

On November the thirtieth of this year, Tarrant County, Texas, formally opened to the public the east end of the Bankhead Highway in that county. This is one of the sixty-eight projects to be constructed under a bond issue of $3,450,000, voted in 1919, and is the first Federal Aid project to be completed in this county.

This particular section, 5.84 miles long, is a part of the main thoroughfare between Dallas and Fort Worth, and probably carries the heaviest traffic of any road in the state of Texas. The location is entirely new, and eliminates eleven main line grade crossings, four of which are double. The maximum grade is 3 per cent. There are but five curves in the project, none having a radius of less than 1,500 feet.

The drainage structures are of reinforced concrete. The project has one bridge of three 28-foot spans, with a very ornamental but easily constructed hand rail.

An unusual feature in reinforced concrete is the under-pass built in front of the Masonic Home for Old and Indigent Masons. This was deemed advisable on account of the high speed traffic at this point.

The drainage structures and all grading were completed under a contract with the Womack Construction Company of McKinney, Texas. The pavement was advertised and let under a separate contract, to the Tibbetts Construction Company, of Mineral Wells, Texas. The pavement is 21 feet wide, over all, 8½ inches thick at the center, and 7½ inches at the curb. It is reinforced with National Steel Fabric wire mesh, weighing 25.6 pounds per square.

* Consulting Engineer, Fort Worth, Texas.

CURBS AND JOINTS

An unusual feature of the design is the 4½x6-inch integral curb, so designed that traffic, in emergencies, can cross over it, yet will not voluntarily make it a common practice; the object, of course, being to confine traffic where it properly belongs, to the pavement, and to reduce the maintenance of the shoulders to a minimum.

The shoulders are sodded with Bermuda grass. The pavement surface is drained through pre-cast concrete outlets, grouted to the pavement, and placed at intervals of 100 feet on alternate sides of the pavement, thus providing an outlet every 50 feet. The surface water is carried from these drains to the bottom of the ditches by grouted rock drains.

Another unusual feature of the design is the method of putting in the construction joints, which were placed at the end of each half-day's run. Seven dowels, 11 inches long, and ⅝ inch in diameter, are set 3 feet apart in each joint, 5 inches of each dowel being inserted in a ¾-inch pipe, 6 inches long, and imbedded 4 inches deep at the end of the run. This prevents any buckling at the joint, yet permits of both expansion and contraction. Commercial elastic filler was used at each joint.

MATERIALS AND EQUIPMENT

The fine and course aggregates used were both shipped in. The sand, a hard, clean and well graded material, as brought in from a pit near Grand

UNDER PASSAGE ACROSS BANKHEAD HIGHWAY

Prairie—a distance of about eight miles. The rock came from the quarry of the Mineral Wells Crushed Stone Company and is all a hand picked, very clean, hard, durable limestone. The cement was obtained from the Texas Portland Cement Company at Dallas. All material was thoroughly tested before using.

The entirely new equipment for this project, purchased by the Tibbetts Construction Company, included a 14 foot L. C. Smith mixer, a Lakewood finishing machine, 1,200 feet of special design steel forms, 600 feet special design steel curb forms, 12 Ford trucks equipped with Lee bodies, pumps, hose, etc. Actual construction of pavement started in June, 1921, and the lay-out for the work was very

carefully planned. Two unloading switches were so located on the Texas & Pacific Railway as to provide a maximum haul of three-quarters of a mile.

The rock was unloaded by hoppers holding exactly 12 cubic feet. They were so arranged as to hook on the side of the loaded gondolas and were slightly unbalanced, the heavy end being on the inside of the car. Long handles attached to the hoppers rested on the opposite side of the car.

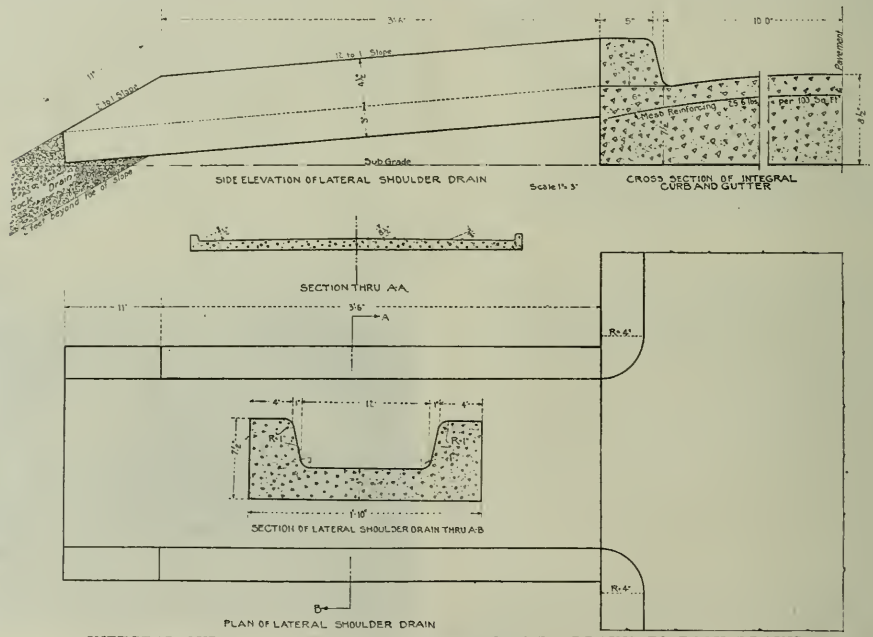
When loaded for dumping, a slight lift on the handle was sufficient to transfer the content to the waiting Lee dump bodies below, the hopper returning to its original position when empty.

The truck however, before taking the stone aggregate, passed first under a sand trap, receiving 6 cubic feet of sand; then passed the cement car, receiving 3 sacks of cement. The truck bodies were all carefully measured, and marked with white paint for the different aggregate content.

four inches of water for two weeks. The material from the dykes was then removed from the pavement to the shoulders, all of which were sodded in Bermuda. The finished road is excellent, and in its many details is the most complete piece of work of this character the writer has ever turned over to the public.

New Highway Construction Course at Pennsylvania State College

N. C. Miller, head of the Engineering Extension Department of Pennsylvania State College, announces that a training course in highway construction has just been prepared for home study by the Engineering Extension Department and can be attained by registration with the Department, so that the course can be completed before construction begins in the Spring, either by home study or by


SIDE ELEVATION OF LATERAL SHOULDER DRAIN
CROSS SECTION OF INTEGRAL CURB AND GUTTER
SECTION THRU A-A
SECTION OF LATERAL SHOULDER DRAIN THRU A-B
PLAN OF LATERAL SHOULDER DRAIN

INTEGRAL CURB AND CONNECTION WITH OPEN SIDE DRAINS TO ROCK DRAINS ON EMBANKMENT

The truck then proceeded to the mixer, passing over a turntable which was kept continually just ahead of the mixer. It then backed to the skip, the contents were dumped by one man, and the operation repeated.

The water content was kept as low as the finishing machine could handle and tamp the mix. It was found that for this thickness of pavement, a wetter mix was necessary for a machine finish than for a hand finish. It was also determined, at least to the satisfaction of the writer, that the pavement as placed, 8½ inches thick, was just about as heavy as this particular finisher could handle in one course.

Every foot of the pavement was ponded under

night classes, thus especially adapting it to the needs of men now engaged in highway construction or maintenance so that they can utilize their spare hours. The examination papers will be handled as if the participants were actually on the college campus, and the instruction will include every possible kind of road and highway work.

Wage Cut In Massachusetts.

On December 14th the Associated Contractors for Massachusetts with a membership covering the entire state, voted that wages in the building industry must be much lower in 1922, and that they would not sign any written agreement with the unions or permit the latter to dictate working conditions.

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Objections to the Imhoff Tank

The Imhoff tank has succeeded the septic tank as the most popular type of sewage treatment in the United States and several score of installations of such tanks are now in operation in this country. However, not all engineers are convinced of the general superiority of this tank over other types of construction for tank treatment.

Although nearly forty Imhoff tanks are to be found in the state of New Jersey (or perhaps some would say *because* of the existence of this number, certain engineers at least of the New Jersey state board of health are not favorably inclined toward the Imhoff tank and believe that equally as good if not better results can, in the majority of cases, be obtained by single-story tanks, which can be both constructed and operated at less cost. In this issue we begin the publication of an article by Russell Riker, assistant sanitary engineer with the New Jersey health board, which will be continued in three or four issues of the paper. This week's installment presents the views of the writer as to the Imhoff tank, which we suppose may be considered as the views of the department, although it is not officially given out as such.

According to the author, Imhoff tanks are not now in such good favor even in Germnay as they were a few years ago. The greater construction cost is undisputed, and Mr. Riker presents figures to show that the operating costs also are greater than for treatment in other types of tanks. In addition, he cites difficulties which have been found more or less generally in the operation of such tanks, notably that caused by foaming.

The article is given as representing the ideas of Mr. Riker personally and publication by us does not imply endorsement of all of his views. It seems desirable, however, to have them brought prominently forward in order that the objections entertained by some engineers to certain of the features may be more generally known, and also with a view to a discussion of these points. We will be glad to receive and publish comments upon Mr. Riker's statements by other engineers either endorsing or controverting them, and our columns are open for this purpose.

Serious Pollution of Streams

A few weeks ago we presented facts and figures from a paper by Kenneth Allen tending to show that the pollution of New York harbor had already reached a dangerous point, and in fact had passed it at certain portions of the waters surrounding Manhattan borough, where the dissolved oxygen was found to be less than 10 per cent. or 15 per cent. of the saturation figure and at certain times to be entirely absent. Recently the Pennsylvania state board of health has called to the attention of the City of Philadelphia that the Delaware river, which forms much the largest part of its waterfront, is in practically the same condition, certain of the tests for dissolved oxygen showing none present.

While the entire absence of dissolved oxygen in each of these bodies of water is only occasional and at certain points, comparison with past figures shows that the condition is becoming continuously worse in this respect, and when the frequency and duration of such conditions increase, a nuisance which will be evident to the senses will inevitably occur. Each of these cities has thus had a most definite and indisputable warning given it that it should at once complete plans and carry out constructions and methods which will tend to reduce the pollution of the waters by its sewage which has contributed most largely to this result.

While these are perhaps the most advanced cases of pollution, there are other streams and bodies of water which are rapidly approaching a similar undesirable condition, notably some of the streams in the northern part of the Mississippi valley basin.

The elimination or even the diminution of these serious conditions involves the expenditure of large sums of money and is not to be undertaken lightly and naturally will not be undertaken at all until the communities become convinced of the necessity in order to preserve their own comfort and health or

until they are required to do so by the state or federal government in order to preserve others from the effects of their acts.

Unfortunately the general public cannot easily be persuaded of the imminence of such undesirable conditions until their own eyes or noses show them that the nuisance has already begun, and as it requires several years to design and carry out the features necessary to prevent such nuisances, they are almost certain to become very pronounced before such works can be completed. In spite of the difficulty of arousing public opinion to a sufficient foresight in this matter, it is the duty of engineers and other officials connected with public health and sanitation to keep everlastingly at a campaign of education designed to bring about a sufficient enlightenment of the more intelligent taxpayers to make it possible to advance, if only by a year or two, the actual undertaking of the works necessary for this purpose.

Public Works in 1921

In the F. W. Dodge Company's review of building operations for the year of 1921 figures are given to show that the amount spent throughout the country for public works and utilities was only second to that used in constructing residences, which latter was 54 per cent. greater than in 1920. The total for public works and utilities is given as $459,184,000.

By districts, the figures for the total expenditure for public works and utilities, and the per cent. each was of the total spent for all kinds of construction in the district, are given as follows:

In New England the total for public works was only 9 per cent. of all expenditures, being $18,973,000. In New York state and northern New Jersey, also, the percentage for public works was small, being 7 per cent. of the total or $45,598,000. In the middle Atlantic states, however, the amount spent for public works was 25 per cent. of the total, being exceeded only by residential expenditures, and amounting to $88,337,000. In the Pittsburgh district, public works took an even higher place, $117,259,000 having been spent, or 28 per cent. of the total construction expenditure, or only about $3,000,000 less than that spent for residences. In the central west, public works lead the residential buildings with $165,801,000 or 27 per cent. of the total construction expenditure. In the northwest the amount devoted to public works was $23,216,000, or only $750,000 less than residential buildings, and 27 per cent. of the total expenditure for construction work.

The forecast for 1922 is that, considering the remarkably good showing for the month of December following the good records of the four previous months, "this year will see a measurably larger volume of construction than the program carried through in 1921." The effort will be toward the expenditure of $4,000,000,000 for the entire country, but the supply of materials, labor and transportation facilities is still inadequate to carry through such a large program. "It is neither likely nor desirable that a program of such magnitude be actually started. Slowness of recovery in general business, labor disputes still unsettled and other retarding factors may be expected to curb a too rapid boom in construction."

Constructing Crystal Lake Sewers

During the Summer of 1921 the E. R. Harding Co., of Racine, Wis., contractors, excavated more than 60,000 linear feet of sewer trenches at Crystal Lake, Ill., in soil composed entirely of sand and gravel with a large amount of boulders from 1 to 4 feet in diameter. The work was done in five months with two Parson's No. 36 gasoline machines, designed to dig a trench 36 inches wide and 15 feet deep and usually operated by five men each, namely—an operator, foreman, pipe-layer, tender and one extra man. The backfilling was accomplished by a Parsons gasoline-driven backfiller machine following the excavator.

Although the material encountered was somewhat loose and unstable, there was little sheeting required for the trenches because the latter were made very wide on top. Although this involved the excavation of a larger amount of material, it could be handled more easily than to excavate less material in a minimum width trench and thoroughly sheet and brace it.

In one of the contracts where the trench was excavated 20 feet through sand, the sides would not stand up as well as in gravel and light bracing was required.

In some cases the gravel was so coarse that it could not be handled by the buckets at first, and continuously rolled back alongside the digger, especially in the deep cut where the inclination of the bucket ladder was very steep. Lengthening the ladder to 20 feet so as to decrease the slope enabled the buckets to handle the gravel satisfactorily .

Where the trench was 17 or 18 feet deep it was 12 feet wide on top, necessitating the use of an extra long conveyor and an additional man at the top of the spoil bank to push the earth back. The same contractors in 1920 excavated 40,000 feet of sewer trench at Libertyville, Ill., in 100 working days.

Pittsburgh Wages

In Pittsburgh wages were quoted for December 1st of $1.00 per hour for carpenters, hoisting engineers, stone cutters, stone masons, structural iron workers, plumbers, sheet metal workers and a number of other trades. The highest wages were $1.30 for bricklayers and $1.12½ for plasterers. All classes received 1½ time for overtime on week days and double time for overtime on Sundays and holidays.

American Engineer Decorated

Dr. J. A. L. Waddell, consulting engineer, bridge expert and author, on December 3rd was decorated by order of the Prince Regent with the Second Class Order of Merit of the Sacred Treasure, in recognition of his services to the engineering profession in Japan, where many years ago he was a Professor in the Imperial University, and for his prominence in engineering education and assistance to Japanese engineers. Dr. Waddell has finished his professional engagement in China and on December 11th sailed from Kobe for the United States by way of the Suez Canal.

Emmetsburg-Mallard Highway

Aggregate for eleven miles of road stored in advance at central point and distributed by industrial tracks and batch boxes. Abundant equipment insured good steady progress.

Federal Aid Project 109 in Palo Alto county, Iowa, is a concrete highway 18 feet wide, 7 inches thick at the edges and 8 inches thick at the centre, which extends south 11.05 miles from Emmetsburg to Mallard, following an old alignment through a gently rolling country, crossing the Des Moines river. The alignment is nearly straight with about 300 feet of a maximum grade of 4 per cent. The construction involved the excavation of about 40,000 yards of gumbo and loam, which was handled with plows and scrapers, and the placing of 115,000 square yards of concrete mixed in a Koehring 21-E paving machine with full caterpillar traction.

The contract was awarded to Brereton & Brauck, Emmetsburg, Iowa, at a price of about $8.00 per linear foot. Work was commenced August 21, 1920, and completed October 5, 1921, with a maximum force of about 65 men and an average force of 50 men, working 10 hours per day and receiving wages of $.50 for labor and $.60 to $1.00 per hour for mechanics, thus developing a payroll of $2,000 to $2,500 per week.

The aggregate used was run-of-pit gravel, dug on the bank of the Des Moines river at a point a mile or two west of the north end of the highway by means of a Sauerman dragline cableway excavator. It was transferred from the stockpile at the gravel pit over an industrial track laid alongside the road to the middle point of the latter, where there was established during the winter of 1920-1921 a 14,000-yard rehandled stockpile.

At the rehandled stockpile, aggregate was loaded by a Barber-Greene machine into 120 Koppel wooden tipover batch boxes of 22 cubic feet capacity. These were loaded in pairs on 64 Koppel road builders' cars and hauled by four Whitcomb 6-ton gear-driven gasoline locomotives over 6¼ miles of 24-inch portable tracks laid alongside the highway from the rehandled pile north to Emmetsburg, thus providing for the delivery of materials to the mixer until the road was constructed from Emmetsburg to the rehandled pile, when the tracks were taken up and relaid from the rehandled pile south to the Mallard end of the road, thus providing for the construction of the whole line with 6¼ miles of track.

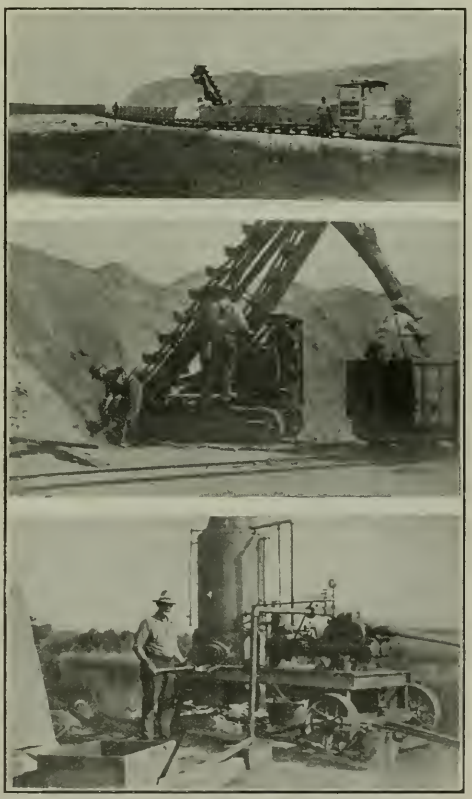
Water was supplied by a Koehring-Gardner steam pump, which with its boiler was mounted on a steel truck and moved from point to point to different supplies, from which it delivered through a maximum of 15,000 feet of 2-inch pipe.

The surface of the ground was finished by a Lakewood subgrader, a 10-ton Kelly Springfield roller and a pressure scarifier.

The paving machine was followed by a Lakewood road finishing machine operating on the Heltzel steel forms of which 2,000 linear feet were provided.

The concrete was mixed with 1.93 barrels of cement per cubic yard, and was placed at a uniformly rapid rate, the best record for one day being 1,075 square yards in eight hours and 1,346 square yards or 673 linear feet in one 10-hour day. The best month's run was 19 10-hour days in the month of August, when there was made a progress of 10,934 linear feet or 21,868 square yards of concrete. During construction, local traffic was detoured to the adjacent fields and through traffic was by-passed around the section, detour signs being posted at all turns.

Fresh concrete was protected with canvas and



TRAIN OF BATCH BOXES AT REHANDLED STOCK PILE
LOADING AGGREGATE FOR TRANSPORTATION TO MIXER
PORTABLE STEAM PUMP SUPPLYING PAVER

21 E KOEHRING PAVER SUPPLIED BY BATCH BOXES

afterwards covered with 2 inches of earth kept wet for 14 days. Trucking was done with one Winther-Marwin 1½-ton 4-wheel drive truck and one 1-ton Ford truck and two 1½-ton Troy trailers. The work was executed under the direction of J. L. Geils, resident engineer.

Laying Concrete Pipe in Soft Ground

The Kansas City, Mo., Water Department has recently laid 9,585 feet of reinforced concrete bell and spigot pipe 58 inches in exterior diameter, under difficult conditions where ingenious methods were developed. The 648 pieces of pipe were cast in sections 12 feet long that weighed 5½ tons each and were handled in the casting yard by a 90-foot steel derrick boom and were hauled to the site over very soft, wet ground by a 10-ton crawler tractor, dragging a 4x16-foot steel-bottom platform with a 24-inch wheel 3 feet long at the rear end, on which the pipes were loaded.

A 7½-foot trench 12 feet in maximum depth was excavated just in advance of the pipe laying by a steam shovel operating at the rate of about 75 linear feet per day. The pipe sections were lowered into the trench by a travelling derrick spanning the trench and the joints were pulled tight by a clamp attached to the last laid pipe and to the new section forcing the latter up against a lead gasket in the bell, after which the joint was completed with cement mortar, trowelled, and the trench was backfilled by machine.

Two sections of 7 x 7½-foot tunnel aggregating 1,800 feet long and from 15 to 30 feet below the surface were driven from seven working shafts 16 feet long and 8 feet wide. As fast as the excavation was made by hand it was lined with 3 x 12-inch planks 7 feet long, the bottom, top and vertical side pieces being successively placed, and the top piece being temporarily secured by screw end braces until the vertical side pieces were inserted between it and the bottom piece and held by short longitudinal cleats nailed across the ends of the top and bottom pieces. The work was done in three 8-hour shifts of 9 men each.

The tunnel was 6½ feet wide in the clear, leaving a clearance of only 10 inches on each side of the pipe, which was delivered on a 12 x 12-inch fixed horizontal cantilever projection from a counterbalanced narrow gage car hauled in and out by a 4-horse power gasoline engine mounted on the car that was also used to lift the pipe.

The pipe was set on 3-inch blocks and a bed of concrete 2-feet wide was placed under the pipes to distribute the load on the bottom of the tunnel.

The tunnel was backfilled with the earth from the spoil banks delivered by teams and slipscrapers to special shafts 50 feet apart, from the bottom of which it was distributed to place by hand. The work was so well done that the ultimate test under 30 pounds pressure showed a leakage of only 21.63 gallons per minute after the pipe had been 10 days in service.

Waterway Development in France

Since the return of Alsace and Lorraine to France, efforts have been made to complete the system of navigable waterways which link up these provinces with the main arteries of French navigation. Considerable improvements have been made in the Rhone-Rhine canal, to facilitate the movement of raw materials and manufactured products of Strassburg toward Lyons and the Mediterranean and vice versa. Work is also progressing on the Marseilles-Rhone canal, which was begun in 1911 and will probably be finished in 1925, the greatest difficulty in construction being furnished by the tunnel through the hills at Marseilles, which is said to be the widest in the world, measuring 72 feet from side to side. This tunnel is 45 feet high and provides for a depth of water of 13 feet and is 4-3/8 miles long.

Plans have been elaborated for utilizing the hydraulic power of the Rhone, the two principal features of which are, first, to utilize the river to the utmost for hydraulic power, irrigation and navigation and, second, to create a single corporation of public and private enterprises benefitted by this use of the river, with the state guaranteeing the finances and after a certain time sharing in the profits.

It is expected to locate 18 power stations along the 326 miles of the Rhone from the Swiss frontier to the Mediterranean. It is calculated that the total energy of the river at mean water is 1,800,000 h.p. and that the cost of carrying out the enterprise will be approximately 3,400 million francs. Projects are also being considered for increasing the transportation capacity and water supply of the canal connecting the Marne with the Rhine, and the extension of the Moselle canal above Metz in the iron ore district; also to extend and increase the transportation capacity of canals in the center and south of France at an estimated cost of 500,000,000 francs.

Philadelphia's Pollution of the Delaware

The State Department of Health of Pennsylvania has sent a warning to the city of Philadelphia that it is seriously polluting the Delaware river with its sewage, and urging it to treat all its sewage or at least a much larger percentage than is now being treated.

Examinations of the river water made last September showed almost complete exhaustion of the oxygen in some of the samples. Shad no longer come up the Delaware river for spawning and the shad fisheries at Gloucester have been destroyed.

Apparently the only way to avoid the transformation of the river from an asset to the city to a liability and a nuisance is to install sewage disposal plants, plans for which were made and approved in 1915.

Recent Legal Decisions

DISCRETION OF CITY COMMISSIONERS AS TO PAVING STREETS CANNOT BE RESTRAINED BY COURT OF EQUITY

The North Dakota Supreme Court holds, Hufford v. Flynn, 182 N. W. 941, that a court of equity cannot properly interfere with, or in advance restrain, the discretion of a board of city commissioners, while such board, in the exercise of powers conferred by the charter or general laws, is considering a proposition as to whether certain streets and alleys in the city are to be paved.

DISCRETION OF CITY AS TO LOCATION AND SIZE OF SEWERS

The Georgia Court of Appeals, Harrison Co. v. City of Atlanta, 107 S. E. 83, holds that "the duties of municipal authorities in adopting a general plan of drainage, and in determining when, where, and of what size and at what level drains or sewers shall be built, are of a quasi judicial nature, involving the exercise of deliberate judgment and wide discretion; and the municipality is not liable for an error of judgment on the part of the authorities in locating and planning such improvements." The action was one for constructing a sewer with too small an eye, resulting in the flooding of a basement. "In determining the location of the sewer and the size of the eye thereof, the municipal authorities were exercising their public or governmental functions, and these were discretionary acts, and as long as an official public act can be upheld as being within the exercise of the discretionary power conferred by the charter the will of the legislative body is supreme, and the courts have no power to interfere."

INJUNCTION TO RESTRAIN OPERATION OF DISPOSAL PLANT OF INSUFFICIENT SIZE WHICH CAN BE ENLARGED

The Texas Court of Civil Appeals holds, City of Pittsburgh v. Smith, 230 S. W. 1113, that a municipal corporation may be enjoined from maintaining and operating a sewage disposal plant or tank too small to accommodate the sewage flowing into it, so that the overflow from the plant pollutes a stream, where the plant can be so enlarged or added to as to abate or stop the continuance of the nuisance. "In operating a sewer the city exercised a corporate power, as distinguished from a governmental function." The court distinguished the cases relied on by the city as having no application to a structure that could be enlarged or added to so as to abate the nuisance alleged and proved here.

TAXATION OF MUNICIPAL WATERWORKS OUTSIDE CITY LIMITS

The Supreme Court of Vermont holds, Town of Orange v. City of Barre, 115 Atl. 238, that where a city is empowered by its charter to take water for domestic, sanitary and general industrial uses beneficial to the public and for protection against fire, and the entire water system is no more than sufficient to provide the city with an adequate supply, the system is within the provisions of the statute relating to exemptions from taxation of property used for public purpose. G. L. 684. But under G. L. 688, the land acquired by a municipality outside its territorial limits is not exempt. This, however, does not apply to reservoirs or aqueducts, nor to water supply, pipe lines, apparatus, machinery or improvements on such land, in any way connected with the maintenance or operation of such reservoir or aqueduct. These are exempt to the same extent as if they were acquired by the municipality within its territorial limits. The fact that, at certain seasons of the year, more water is supplied by the water system than is required for its municipal purposes, which is sold by the city for mechanical uses, does not deprive the property of its character as property used for a public purpose.

MUNICIPAL CONTRACTOR HELD ENTITLED TO RECOVER DAMAGES CAUSED BY BAD FAITH OR INEXCUSABLE IGNORANCE OF ENGINEER

Although a municipal contract provides in effect that the contractor shall be subject to the orders of the engineer and to the construction he gives to the plans and specifications, that does not mean that he has no recourse where bad faith or inexcusable ignorance is shown by the engineer resulting in damage to the contractor, First Savings & Trust Co. v. Milwaukee County, 158 Wis., 207, 148 N. W., 22, 1093. Such provisions imply that the engineer shall act in good faith, and that he is possessed of a reasonable degree of skill and care, and will in good faith exercise the same in giving orders and in performing his part of the contract. Where bad faith or inexcusable ignorance is shown to have resulted in damages to the contractor, who in good faith relied upon the directions of the engineer or upon the correctness of the work performed by him, then the contractor may recover the damage proximately sustained by him by reason of such bad faith or inexcusable ignorance. Nelson v. City of Eau Claire (Wis.), 185 N. W., 168.

LETTING OF CONTRACT—EXTENSIONS OF TIME FOR BIDS MUST BE ADVERTISED

Under the provisions of a city's improvement ordinances bids were to be advertised for and the contract let on August 1, 1914. At a regular meeting of the board of trustees, held on that date, it was reported that no bids had been received for the brick paving, nor for the construction of sewers, and the time for receiving bids was extended to August 1, 1914. Other than the sending of telegrams and the writing of letters by the city attorney and city engineer, nothing was done by the authorities between August 1st and 10th to advertise for bids for the contemplated improvements. There was no publicity given of the fact that there had been an extension of time for the reception of bids. The Court of Appeals of Kentucky holds, Preston Land Co. v. Town of Paintsville, 234 S. W., 445, that, under Ky. St. §5706, requiring street improvement contracts to be awarded, by cities of the sixth class, to the lowest bidder after advertisement, a property owner was not liable on an assessment for the cost of the improvement constructed under a contract awarded August 10.

NEWS OF THE SOCIETIES

CALENDAR

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERS. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—C. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28—ARKANSAS CHAPTER, A. A. E. Little Rock, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 30-Feb. 1—NATIONAL CIVIC FEDERATION. 22d annual meeting. Hotel Astor, N. Y. C.

Feb. 4-11—ST. PAUL BUILDING EXCHANGE EXPOSITION. St. Paul, Minn.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention, Cleveland. Secretary, Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' Bldg., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting, Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23—MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; April. 30, Youngstown, O.

May 15-19 AMERICAN WATER-WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular monthly meeting January 11th, the subject was "Traffic Handling—Its Engineering as Well as Regulatory Aspects."

The topic was presented by E. P. Goodrich and Amos Schaeffer, and was discussed by:

Robert Grier Cooke, president of the Fifth Avenue Association, which has made exhaustive studies of traffic in the Fifth Avenue section; New York.

Dr John A. Harriss, Special Deputy Commissioner of Police, in charge of traffic regulation for the City of New York;

Clifford M. Holland, Chief Engineer, New York State Bridge and Tunnel Commission and New Jersey Interstate Bridge and Tunnel Commission, which have made traffic studies to determine location and details of the tunnel entrances and exits;

And by A. T. Warner, Traffic Engineer, Public Service Railway Company, Newark, N. J., who considered the interrelation of electric railway and vehicular traffic.

AMERICAN CONCRETE INSTITUTE

Tentative program of convention at Hotel Winton, Cleveland, February 13-16.

February 13: Meeting of chairmen of all committees to discuss future work of the institute. Report of Committee S 6 on Concrete Roads. Presentation and discussion of revised standards. Discussion of Plant and Material Handling Problems.

Evening: Report of Committee S 5 on Reinforced Concrete Houses, New Building Regulations. Papers and addresses by two or three builders of Concrete Houses—no theory—no guesswork—no untried conjectures—actual experience on how it is being done. One of these addresses will be by Miss Kate Gleason, Rochester, N. Y., whose concrete houses are close to the hundred mark—*all sold—at a profit.*

February 14: Report of Committee E 3—Research; a survey of important research which is being undertaken by various agencies and of research for which there is need. Presentation of the Wason Medal. Announcement of the work of Committee G 3 on Form of Standards. Business session. Report of Committee P 1 on Standard Concrete Building Units (New Standards for Block, Brick and Structural Tile). Report of Committee P 5 on Fire Resistance of Concrete Building Units. Report of Committee P 4 on Concrete Staves (special reference to strength and testing).

Evening: Report of Committee J 2 on Concrete Pipe. Report of Committee P 7 on Concrete Pipe, Drain Tile and Conduit. Report of Committee P 6 on Products Plant Operation, leading a general discussion of plant layout, equipment and operation problems.

February 15: Engineering Design and Inspection. Report of Joint Committee on Concrete and Reinforced Concrete. The report will be discussed by major subjects, led by chairmen of local committees of contractors from New York, Boston, Philadelphia, Chicago, and elsewhere, and by chairmen of institute standing committees whose work involves a special consideration of subjects covered in various sections of the Joint Committee Report. The discussion will be centered chiefly upon: 1. Quality of Concrete—Proportioning, Mixing and Placing. 2. Details of Construction—Fireproofing and Construction Joints. 3. Waterproofing — Protective Treatments (special reference to Corrosion of Steel Reinforcement).

Business Session.

Afternoon: Continuing discussion of Joint Committee Report.) 4. Surface Finish. 5. Design with particular reference to Proposed Design Requirements on Cost of Construction.

Evening: An informal, social, get-together, with cider and doughnuts.

February 16: A study of Proportioning Materials and Consistency, Slump Tests, Test Cylinders. A demonstration of sieve analysis of aggregates, water control, slump tests and casting test cylinders as a means of relating laboratory knowledge of Field Methods. Report of Committee C 1—Contractors Plant. Report of Committee C 2, Concrete Floor Finish—Presenting Simplified Standard Specifications, followed by two brief papers on Special Floor Finishing Methods. Report of Committee C 3 on Concrete Surfaces. Changes in Stucco Practice, Exterior of Industrial Buildings, Special Decorative Effects, Interiors of Buildings, Bond of Applied Coatings. Report of Committee C 4 on Metal Forms. Paper on Repair of Concrete Ships. Paper: Graphic Determination of Stresses by Prof. George E. Beggs.

THE NATIONAL CIVIC FEDERATION

The Twenty-second Annual Meeting of The National Civic Federation will be held at Hotel Astor, New York City, Jan. 30-Feb. 1.

Among the questions to be discussed are:

Shall the United States Railroad Labor Board be abolished, be given more "teeth," be annexed to the Interstate Commerce Commission, be replaced by industrial courts along the line of the Kansas Court of Industrial relations, or

Does the voluntary principle, upon which is based the Four-Power Treaty dealing with international controversies, furnish a more effective method for handling industrial disputes?

Are all interests in industry better safeguarded by the shop representation plan or by the trade union plan?

Does collective bargaining conflict with the Sherman Anti-Trust Law or the various state laws prohibiting contracts in restraint of trade?

TRENTON ENGINEERS' CLUB

The Trenton Engineers' Club has elected the following officers: president, Harry F. Harris; vice-president, Edward E. Reed; secretary, Joseph E. English; and treasurer, James H. Johnson.

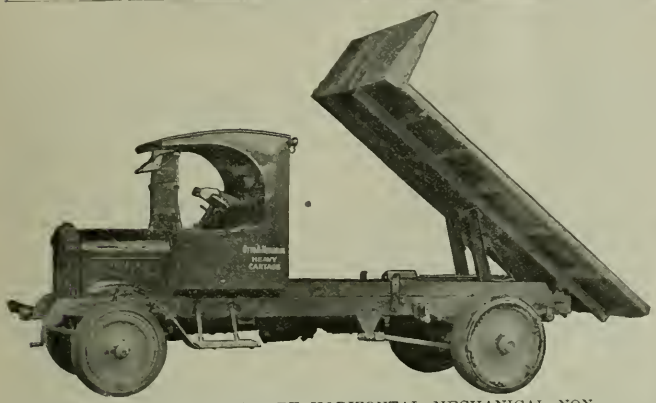
ASSOCIATED PENNSYLVANIA HIGHWAY CONTRACTORS

On December 15th and 16th the Associated Pennsylvania Highway Contractors held their Second Annual Meeting

(*Continued on page 56*)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



DUMP BODY OPERATED BY HORIZONTAL MECHANICAL NON-HYDRAULIC HOIST

PERFECT HOISTS

The Perfect horizontal-mechanical non-hydraulic hoists manufactured by the Perfection Hoist & Engine Co., are screw operated with power supplied from the truck transmission and controlled by a clutch controlled from the driver's seat. The mechanical action of the self locking screw enables the body to be elevated and locked at any angle up to 45 degrees where it is automatically sustained without danger of slipping, thus providing for road building where a spreading device is used or any other purpose where it is necessary to keep the body tilted for any length of time. No portions of the hoist project below the truck chassis. The self locking nuts support a patented equalizing device attached to the lifting cables. The nut travels on the screw operating the two cables, which raise the body or lower it by reversing the screw. The body is automatically stopped when reaching the full tilting angle or the original horizontal position.

The hoist is claimed to secure the use of full loading space on the truck chassis and allow the use of bodies from 12 to 24 inches longer, and with lower sides than bodies of equal capacity using the vertical type of hoist. The hoisting stresses are distributed over a length of 57 inches without concentration while the average vertical hoist distributes its strain over 18 to 24 inches.

The hoists are made in sizes of from 2 to 8 tons capacity; the number of working parts is reduced to a minimum; all parts is standardized and interchangeable; the efficiency is not impaired by cold weather; deep ruts and rough roads do not affect its operation, and it requires no oil, no pumps, no pipes and has no leaks.

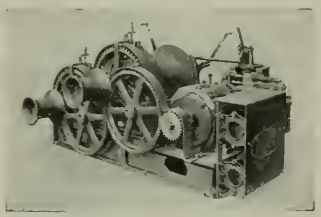
NEW P & H CONTRACTORS' HOIST

Pawling & Harnishchfeger Co., has standardized a line of contractors' stationary hoists, two illustrations of which are shown in the accompanying views. These hoists are made in types for electric, gasoline and belt drive, in sizes ranging from 8 HP. with 8x12-inch drum, up to 115 HP. with 18x29 inch drum. The long experience of the Pawling & Harnischfeger Company in building its own hoist drums, electric motors, controllers, and brakes used on its traveling cranes and monorail hoists has been drawn upon in the development of the stationary hoist line. For the gasoline-driven hoists, motors of the types that have been proven successful in P. & H. gasoline excavator-cranes, trench excavators, gas shovels and dragline excavators are used. These are in all cases of the heavy duty four-cylinder vertical tractor type with Bosch Magneto, Master Carburetors, Stewart Vacuum System and air cleaners. Automatic throttle governors are provided and conveniently located hand throttles.

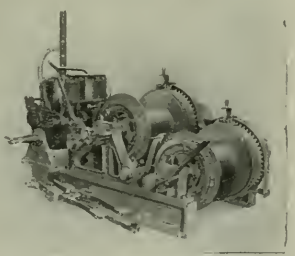
The same high quality electrical apparatus as furnished on P. & H. electric traveling cranes and hoists is used on all P. & H. electric driven contractors' hoists.

The belt-driven types are similar except that the rear end of the bed frame is left off, and a large size driving pulley is provided on the side opposite the operator. The construction for all types is similar—the bed plates and side stands are of box and I-beam section design with heavy cross girders and bottom and top flanging. Plates are accurately planed and side-faced. Through bolts only are used, and all holes are drilled in jigs and fixtures. All drum shafts are of high grade carbon steel, turned and ground to exact size teeth, and motor pinions and gears are hobbed. Drum gears are of solid web type with large hubs pressed in place on the shafts by hydraulic pressure against a shoulder.

The friction mechanism is of the standard V design; the friction blocks are of specially seasoned maple, accurately turned. Brakes are operated by means of foot levers located conveniently to the operator's feet. Full contact of the brake bands is insured because they are worked-in on drums and peened to conform to the drum surface before placing on the hoist. This is done so that the user does not have to wear the brakes in. Counterweights are provided for all brakes insuring a quick release.



TWO-DRUM ELECTRIC STATIONARY HOIST



TWO-DRUM GAS STATIONARY HOIST

INDUSTRIAL NOTES

The Combustion Engineering Corporation, New York, has opened a new branch office at 806 First National Bank Bldg., Pittsburgh, Pa., in charge of W. G. Stripe, formerly manager of the Philadelphia office.

The Portland Cement Association at its annual meeting re-elected as president L. T. Sutherland; first vice-president, Richard Hardy; second vice-president S. B. Newberry; and treasurer, F. W. Kelley.

The Orton & Steinbrenner Co. of Chicago manufactures locomotive cranes, clam shell and orange peel buckets and coal crushers, have made arrangements with Walter Hasendahl, 1213 Fuller Ave., Los Angeles, Cal., to represent them.

Acquisition of the Boonton Electric Company and the United Electric Company of New Jersey by the Morris and Somerset Electric Company, has been approved.

The Hogan Ditch Company has been incorporated by Robert Milne and Sievert O. Midland of Big Timber, at Big Timber, Mont., to build and operate irrigation ditches and plants.

John R. Alpine has been appointed New York department manager of the Grinnell Co., representing the company's power piping, steam, and hot water industrial piping interests.

The Associated Machinery Corp. has been formed by Pawling & Harnischfeger Co., Novo Engine Co., Insley Manufacturing Co., Blaw-Knox Co., and the Chain-Belt Co., for the purpose of exporting construction equipment and other products of American manufacture to India, Burma and Ceylon.

The Osgood Company of Marion, Ohio, has recently opened a branch sales office in the Conway Bldg., Chicago, in charge of Arthur B. Sonneborn.

PERSONALS

Curley, James M., former mayor of Boston, was again elected mayor on December 13th.

Horr, B. L., was appointed county highway commisioner of Oneida county, Wis., to succeed Frank E. Parker.

Humeson, C. N., has been appointed city manager of Lufkin, Texas.

Manning, William B., of Michigan City, Ind., has been appointed city manager of that city.

Maier, Harry L., for 17 years engineer in charge of sewers for Wilmington, Del., has been appointed chief municipal engineer of that city.

Staley, P., has been appointed city manager of Fort Myers, Fla.

Fullerton, Howard R., formerly in the sanitary engineering division, U. S. Public Health Service, has been appointed assistant sanitary engineer for the Tennessee state department of health of disposal and water supply work.

Peterman, William T., highway contractor, St. Landry, La., has been appointed chairman of the Louisiana State Highway Commission.

Beebee, Ralph A., has been appointed chief harbor engineer by the Oakland, Cal., city council.

(Continued from page 54)

and Highway Construction Industry Conference at Harrisburg.

The slogan of the meeting was: "A dollar's worth of construction for every dollar of road bonds."

The first day was devoted to reports from the following committees: Legislative, specification, membership, labor, materials, transportation and publicity.

The Legislative Committee, Charles A. Waters, chairman, reported the passage by the 1921 Pennsylvania Legislature of four contractors' relief bills. The Governor signed one and vetoed three, due to doubtful constitutionality.

The Specification Committee, E. P. H. Harrison, chairman, emphasized the necessity of cutting down overhead expenses by elimination of risk in the various clauses. It was stated that from 10 to 15 per cent. of the cost could be saved for other construction. The suggestions are being presented to the State Highway Department for their consideration.

The Membership Committee, Wm. D. Hill, chairman, reported a growth for the year of 115 per cent. The number of members is close to the hundred mark and this list contains the names of the greatest road building firms in America.

The Labor, Material, Transportation and Publicity Committees reported on their successful activities for the year.

The following officers were elected: William D. Hill, Pittsburgh, Pa., president; Samuel M. Irwin, Philadelphia, Pa., first vice-president; Lea Hunt, Wilkes-Barre, treasurer; H. H. Wilson, Muncy, Pa., director 1922-23; Walter Rae, Pittsburgh, director, 1922-23; E. H. Shank, Erie, Pa., regional vice-president; Henry Baton, Philadelphia, Pa., regional vice-president; B. G. Coon, Luzerne, Pa., regional vice-president; J. C. Devine, Alliance, O., regional vice-president. Chas. F. Puff, Jr., was continued as secretary and general manager.

On December 16th the conference, with about 200 representatives from all branches of the industry, was opened by Mayor Hoverter of Harrisburg. All phases of road construction were discussed by the following speakers:

Bankers' Viewpoint, E. J. Stackpole, Director Harrisburg National Bank.

Surety Co's Viewpoint, Edward C. Lunt, Vice-President Fidelity & Casualty Co.

Cement Producers' Viewpoint, Wm. C. McIntyre, Atlas Portland Cement Co.; Ernest Ashton, Lehigh Portland Cement Co.; W. D. Cloos, Edison Portland Cement Co.

Coarse Aggregate Producers' Viewpoint, Wm. Beacham, General Crushed Stone Co.; Al. Hooker, Buffalo Crushed Stone Co.

Fine Aggregate Producers' Viewpoint, J. E. Carrell, J. E. Carroll Sand Co.; Alex. Dann, Keystone Sand & Gravel Co.

Asphalt Producers' Viewpoint, Wm. J. King, The Texas Co.; Louis Young, Atlantic Refining Co.

Mechanical Handling of Road Material, R. M. Gates, Lakewood Engineering Co., Edward M. Ornitz, Blaw-Knox Co.

Equipment Mfgs.' Viewpoint, H. P. Goodling, Galion Iron Works & Mfg. Co.; George Sherron, Koehring Company.

Penna. State Highway Dept., Howard Fry, Secretary, Highway Commission; John C. Hildebrandt, Comptroller; Chas. H. Moore, Traffic.

Publicity, R. K. Tomlin, Associate Editor, Eng. News Record; Wm. Jabine, Editorial Director, Successful Methods; W. S. Hays, Gen'l Secretary, Nat. Fed. Constr. Industries; Wm. C. Perkins, Eastern Pav. Brick Contr. Assoc.

The motif of the meeting was Wm. Penn's treaty with the Indians. Following the example of the founder of the great Commonwealth of Pennsylvania, all branches of the industry brought their problems to the conference.

Peace, harmony, confidence and good will marked the deliberations and closer co-operation with a reduction in highway construction costs should result.

At the banquet in the evening, Henry H. Wilson, the retiring president, acted as toastmaster. The other speakers were Lieutenant Governor of Pennsylvania, Edw. E. Beidleman; Daniel Garber, Organizer of A. G. C. of America; W. O. Winston, president of Associated General Contractors of America; William D. Hill, president-elect of A. P. H. C., and Chas. F. Puff, Jr., secretary and general manager.

ENGINEERING INSTITUTE OF CANADA, MONTREAL BRANCH

The Engineering Institute of Canada, Montreal branch, at its opening meeting presented a medal to Roger French for his paper, "Reinforced Concrete Covered Reservoirs." At the evening session A. E. Doucet presented the first of a series of papers to be given on the Montreal aqueduct, in which he outlined the whole waterworks scheme of the city.

WASHINGTON SOCIETY OF ENGINEERS

At its annual meeting the Washington Society of Engineers elected these officers: president, John S. Conway; vice-president, R. H. Dalgleish; secretary, A. C. Oliphant; and treasurer, O. B. Brench.

SAN FRANCISCO SECTION, A. S. C. E.

The San Francisco section of the American Society of Civil Engineers held its annual meeting on December 20th. The paper of the evening, presented by Charles Gilman Hyde, professor of sanitary engineering, University of California, was "The New Pumping and Filtration Works of the City of Sacramento, Cal." The following officers were elected: president, Thomas H. Means; first vice-president, Frank G. White; and second vice-president, G. A. Elliott.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 JANUARY 28, 1922 No. 4

Utilizing Small Stream Valleys for Traffic Routes*

By Jay Downer †

How the Bronx River, which with its banks had become a public nuisance, was turned into an attractive location for a great pleasure traffic route. An illustration of the improvement is shown on the front cover

The valleys of our larger streams are so commonly used for traffic routes that it is quite unnecessary to call attention to their advantages. This discussion is, therefore, limited to the protection and use of small stream valleys in the vicinity of centers of population. In the beginning we may as well face the fact that every small stream valley in or about a center of population is destined to be either a substantial asset or a definite liability to the city through which it flows. If it is taken in hand, protected and utilized, with marginal lands acquired by the municipality, it will usually afford excellent location for traffic routes, trunk sewer lines and parkways, which will substantially increase property values in its zone. While on the other hand, if left to shift for itself, unprotected, such a stream valley is almost certain to degenerate into a nuisance zone with distinctly depressing influence on property values and, with the growth of population, presenting an increasingly difficult problem, which ultimately must be solved at a cost for abating the nuisance that may easily be many times the cost of providing a parkway and important traffic route, if reasonable foresight had been exercised.

As an illustration of the problem I will describe how a particular case—that of the Bronx river in and adjacent to the city of New York— has been reclaimed and utilized for what is destined to become one of the world's greatest pleasure traffic routes—the Bronx River Parkway.

The Bronx River Parkway Reservation extends for a distance of 15 miles, from the Botanical Gardens of Bronx Park, in New York City, to the great Kensico dam, four miles north of White Plains, the county seat of Westchester county. The Bronx river is a small stream coming down out of the Westchester hills and emptying into Long Island Sound. It has a beautiful valley between ridges roughly parallel north and south. Bold and rocky in some places, there are expanses of meadow land in other portions; in short, the diversity of scenery that Westchester county is noted for. The New York and Harlem railroad closely follows this water course and with the development of towns and villages along this railroad there came the inevitable sewage pollution and discharge of factory wastes. The Bronx river went from bad to worse year after year and served as a channel to convey the accumulated filth of the valley towns such as White Plains, Mount Vernon and the upper portion of Bronx Borough, into Bronx Park, through which the river flows and enlarges into several small lakes. Unfit for decent human habitation, the river banks in the towns were cluttered with stables, shacks and small factories, which, with the stream itself, formed an unsanitary nuisance affecting extended areas.

More than 25 years ago, in 1895, the polluted condition of the Bronx river attracted sufficient attention to bring about the appointment by the Governor of an investigating commission. This commission employed an engineer, who wisely recommended that the low lands along the river be acquired, not only to fully protect the river from pollution, but to provide ample width for a trunk sewer and an important traffic route or parkway drive. The shortsightedness of those commissioners in refusing to adopt the recommendations of their engineer has cost the people of New York City and Westchester county many millions of dollars, for if the parkway had been established at that time, the necessary lands could have been acquired at a mere fraction—certainly not more than one-fifth—of the present cost. This 1895 commission recommended instead that a sanitary trunk sewer be built paral

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driveway will be use
at the end of 1923.

The work done by
of nuisance

* Paper before American Road Congress, Chicago, Ill., Jan. 18, 1922

† Chief Engineer, Bronx Parkway Commission, New York.

to the river. The question of enclosing the entire river in a big storm sewer was discussed, but discarded, it being impracticable to build a storm sewer large enough to carry the flood waters. That commission's recommendation to expend a large sum for the construction of a sanitary sewer did not appeal to the public imagination and nothing resulted therefrom.

Ten years elapsed and it became absolutely necessary from a sanitary standpoint to clean up the situation. Another investigating commission was appointed in 1906, which recommended that the most feasible solution, having regard for economy and return in public utility, was the creation of a parkway reservation, which would include the low lands and immediate slopes along either side of the river. The commission pointed out that this was the cheapest way to protect the river and that the land to be acquired would provide locations not only for a sanitary sewer, but for a great parkway with traffic artery extending from New York City's park system 15 miles along the picturesque river to the magnificent Kensico dam and reservoir, where the city owns 4,500 acres of beautiful woodland and lake areas. These recommendations were adopted as a joint project of New York City and Westchester county, and the legislative act provided for acquiring about 1,200 acres of land along the river, elimination of sewerage pollution and development of a parkway.

With the passing of time there had been a steady increase in land values in all suburban districts around New York City, and lands in the Bronx river valley, which could have been acquired a few years earlier at much lower cost, had so advanced that the 1,200 acres worth 25 years ago, perhaps, one and a half to two million dollars, are now costing in spite of the utmost economy in acquisition, upwards of $8,000,000. In the meantime, the natural beauty of certain sections of the valley had been almost totally destroyed and the restoration of these sections has added to the heavy cost of delay in starting the project. The Parkway Commission, however, made the best of the situation and as soon as the lands were acquired, the nuisances were abated, garbage and refused cleaned up, and over one hundred and fifty cases of pollution were eliminated. With the river and reservation finally clean, the commission found itself, in 1919, with the funds in hand for proceeding with the improvement program, the main feature of which was the construction of a parkway drive 40 feet in width connecting the city's boulevards at Bronx Park with the magnificent system of state roads diverging from the northerly terminus of the new parkway at Kensico dam.

located in a parkway
reservation, varying in wi h from 200 to 1,200 feet,
with an average width of 500 feet, will provide an
outlet for pleasure traffic tremendous value to the
great metropolis. The v rk of constructing the
driveway is about one-ha finished and the traffic
on the sections already ened indicates that the
driveway will be used to apacity when completed
at the end of 1923.

The work done by the Commission includes the
chief engineer of parks and playgrounds, Cal., elimination of nuisances, removal of the 355 shacks

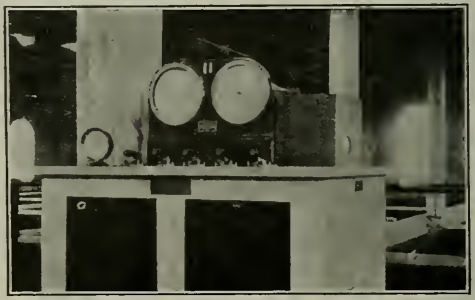
and third-rate buildings, drainage of swampy areas, regulations of river, filling and grading, and finally the construction of bridges and paving of the driveway with concrete base and asphaltic surface. There were many picturesque features, which the Commission was able to preserve in the upper portions of the reservation, which were more remote from centers of population.

Duluth Planning by Engineers' Club

The Duluth Engineers' Club has been asked by the Civic Council, which represents a number of civic organizations, to submit a general plan for sewage disposal and water supply, this action having been taken at the request of the Duluth Board of Realtors. It is not felt that any particular crisis exists at this time, but this move is made in order to anticipate any future necessities. The water used by the city is withdrawn from the lake into which the city discharges its sewage, and is now being treated with chlorine, apparently satisfactorily, but as the population increases it will probably become necessary either to move the intake beyond its present position nine miles from shore or to secure a more complete treatment of the water. The chief point which it is desired that the Engineers' Club advise the city on is whether the treatment of the sewage or some change in the taking and purifying of the water would be the preferable solution.

Sensitive Turbidity Detection

In our issue of January 7th we described a device which had been developed at the Montebello filters, Baltimore, for sensitive detection of suspended matters and turbidity in the effluent from the filters. After the article had been received from Mr. Baylis, he sent us a photograph showing one of the turbidity detectors mounted on an operating table at the Montebello filters. Owing to a strike of the engravers in New York we were unable to have an illustration prepared from this photograph in time for the January 7th issue, but we are presenting the cut herewith. This gives an idea of the size and general appearance of the box containing the appliance. The observation hole will be seen on the side of the box near the right hand end of the table.



TURBIDITY DETECTOR ON OPERATING TABLE AT MONTEBELLO FILTERS

Sewage Treatment in Imhoff Tanks*

By Russell Riker

Details of design, including settling chamber, scum boards, baffles, slots, gas vents, sludge digestion chambers, scum troughs, sludge beds, etc.. Instructions for operating tanks.

Settling Chamber: The ratio of the width of the settling chamber to the length should not be greater than one to five. The depth should be such as to keep the velocity as low as possible. If the velocity is kept low the length can be reduced. Dr. Imhoff recommends .03 foot per second with a maximum of 0.1 foot per second for maximum flows. The velocity used in the design of New Jersey longitudinal flow tanks ranges from .02 to 0.1 foot per second. This velocity has been increased in a number of cases where not all of the original tanks have been used or where the flow is greatly increased over the original estimate. At Plainfield the velocity has been increased one-third and at Princeton from .04 to .12 foot per second. Experiments at Columbus indicate that a velocity of .013 gave a good reduction in the settleable solids. Experiments carried out with current meter at Plainfield would indicate that the velocity does not remain the same at any two places in the tank. Sections taken across the tank indicate that the velocity is speeded up near the side walls. We have found that there is a great difference between velocity at different depths in the tank. Aniline dye placed in the inlet end of the settling tanks has appeared at the outlet end in twenty minutes where the normal detention of the tank was several hours, indicating that the surface velocity was very much higher than the other velocities.

The economical capacity of the settling chamber should be such as to give the sewage 1½ hours' average detention, based on the average flow per 24 hours. Dr. Imhoff used 1½ hours for the detention period for German design, but recommended 2 or even 3 hours for weaker American sewage. Provided the velocity is low enough, the greater amount of settleable material will settle out in the first 15 feet of travel, leaving fine colloidal material that will take hours to settle out. It has been found where an Imhoff tank has three or more sludge compartments, the central compartment or compartments have practically no sludge in them. The original army tank was also a good example of this phenomnon. A review of the detention period in the New Jersey Imhoff tanks indicates a minimum detention period of 1½ hours and a maximum of 4 hours.

The sloping side walls vary from 1 to 1 for the Westfield plant to 1 to 1½ for the Oaklyn plant. Experience indicates that the side walls of the Westfield plant do not have enough slope, this in spite of the fact that George D. Hammond in his experiments at Brooklyn found that side walls with as low a slope as 42° proved satisfactory. The success of the operation at Brooklyn may, however, be due to the type of slot used at that station, which will be discussed later. The average slope used with success is 1 horizontal to 1.3 vertical. The top of the side walls of the settling chamber should be provided with walks so that the attendant can easily skim the settling chamber.

Scum Boards and Baffles: Contrary to the results obtained in Mr. Hammond's recent investigations at Brooklyn, experience in New Jersey indicates that deep baffles are not necessary. Very few of the plants have deep baffles, while at some places where deep baffles were originally constructed they have been withdrawn and good sedimentation has been obtained with the majority of these tanks. Most of the designs call for a scum board at the influent and effluent ends about 2 feet from the weirs. It is not wise to place the scum board too close to the weirs as the increase in velocity at this point may draw some of the floating material over into the effluent.

Slots: It is believed that the type of slot recommended by Mr. Hammond is a decided improvement over the old design. In the former design one or both planes of the sloping sides walls of the settling chamber were obstructed, but in this design an "A" shaped gas deflector has its upper surface in the same plane as the slopes of the settling chamber, allowing a free fall into the lower compartment. Several plants have slots constructed in such a manner in New Jersey. These plants have caused noticeably less trouble in cleaning the side walls. With such a design it may be possible to use a 6-inch slot with success, but our experience in New Jersey, where the majority of slots are 6 inches, would in-

CHIMNEY TYPE OF GAS VENTS

*Continued from page 42.

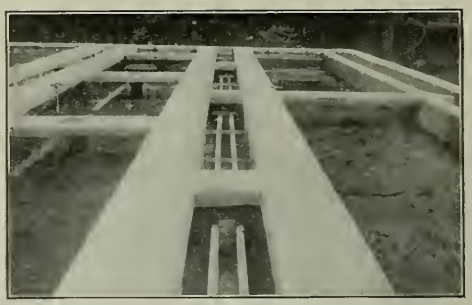
dicate that a slot 8 inches in width is advisable. The gas deflector or bottom of the sloping side walls of the settling chamber should be so constructed as not to interfere or hold back any sludge in the process of rising or falling. At Princeton it is believed that the peculiar construction of the bottom of the side walls and gas deflector catches much sludge and holds it in suspension.

Gas Vents and Scum Chambers: There are several different forms of gas vents; the most popular of these being the longitudinal rectangular gas vents, the chimney gas vents and the segment gas vents. The form bears a close relation to the area, which has been much discussed by engineers. Some think that it should be as small as possible and the chimney as well as the segment type illustrates the practical application of this idea. Other engineers advocate very large gas vents.

Experience in this state would indicate that longitudinal gas vents running the entire length of the tank are the better. A small gas vent is easier to work and perhaps keeps the floating scum waterlogged, but large areas give the floating sludge more of a chance to rise to the surface and liberate its entrained gas. It has been found, however, that too little attention has been given to the capacity of the scum chambers, that portion of the gas vents above the slot, and it is suggested that the capacity of this chamber be as great as the capacity of the sludge digestion chamber. The per cent which the area of the gas vent is to the area of the settling tank ranges from less than 5% to 44%. We cannot recommend that a certain area will prove satisfactory, although it can be stated that the areas of the gas vents in New Jersey tanks are in general too small and that foaming over the top of the gas vents very seldom occurs with large gas vents. Large gas vents do not prevent belching or rising of the floating sludge through the slot to the surface of the detention chamber.

Sludge Digestion Chamber: The sludge digestion chamber may be round or rectangular. The round sludge chamber may give the better results, but it is not thought that the increased cost of construction pays for the results obtained. Of course, it is advantageous to eliminate any dead area where digested sludge may collect and not mix with the incoming fresh sewage. Capacities range from 0.7 to 1.9 cubic feet per capita, averaging slightly above 1 cubic foot per capita. A capactiy of over 2 cubic feet per capita is preferred.

The bottom of the sludge chamber should be in the shape of a cone or truncated pyramid and the greater the slope of the walls of this chamber the better. The sludge chamber is usually divided into square compartments and sludge drawing facilities are provided for each compartment. The greatest trouble with such a division is that the good and bad sludge do not mix properly. Attempts have been made to cut holes in the partition walls but this has not improved operation. Of course, the heavier larger particles will settle in the primary compartment, with correspondingly poorer sludge in the succeeding compartments. Reversing the flow helps out the two end compartments but the good sludge in the central compartments does not mix with the fresh sludge. It hardly seems necessary to construct such division walls.



NARROW GAS VENT WITH TROUGH IN WESTMONT

Sludge Pipes: The average sludge pipe size is 8 inches. Care should be taken that the end of the pipe is neither too near nor yet too far from the concrete side walls or bottom. If screens and grit chambers are used they should not become clogged.

Scum Pipes or Troughs: Experience indicates that at practically all plants, scum collects in large quantities in the gas vents. Usually this scum is well digested and odorless and it can be drawn off on the sludge bed. Due to the large gas content it dries faster than the bottom sludge. It is suggested that apparatus for removal of floating sludge or scum be installed. Pipes or troughs can be constructed at little additional expense and may be a great saving in the end. This conveyor should be constructed about 1 foot below the water level.

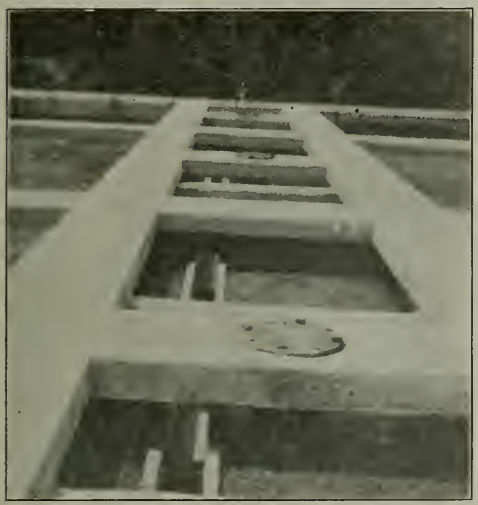
Such a design has been followed in the construction of the Haddonfield and Westmont sewage treatment plants. At the end of the longitudinal gas vent is a sluice gate. This gate opens into a small concreted box, the bottom of which contains an opening to a 6-inch pipe leading to the main sludge bed. In the gas vent (which is longitudinal) a narrow, deep steel trough runs the entire length, connecting with the sluice gate at the end. The top of the longitudinal trough is at the same elevation, a few inches above the water level, throughout. The bottom is given sufficient grade toward the sluice gate in order to allow for a good velocity of flow in the trough. To facilitate the flow in the trough, the bottom of it is connected with the settling chamber by pipes so that, by opening a valve, water enters the trough under a small head equal to the difference between the level of water in the settling chamber and the bottom of the trough. These tanks have been in operation only a short time and we are unable to state with what success the trough will operate, although there is some objection to obstructing the gas vent area even with sludge pipes; also it may prevent the breaking of frozen floating scum.

Sludge Beds: It is generally agreed that sludge bed area must be made larger, especially with the climate in New Jersey where not more than ten dryings per bed can be obtained per year. At Plainfield, where no industrial wastes are treated, Mr. Downes has obtained but 5.8, 6.0 and 5.8 dryings per bed for the last three years. He has made

the following computation: "Assuming that the depth of sludge on the bed is 9 inches and that the actual amount of sludge discharged from the tanks is 108,000 cubic feet from 35,000 population, the sludge bed area needed is equal to 144,000 square feet drying surface per year and $\frac{144{,}000}{6} = 24{,}000$ square feet drying area to care for 35,000 persons, or .686 square foot per capita."

OPERATION

When the two-story tank was first introduced the general impression was that it would operate satisfactorily with every little attention. After a short survey of early American experience with the tank, Dr. Imhoff stated that it would be necessary to remove the light floating material on the surface of the tank about twice a week.



WIDE GAS VENT WITH TROUGH, HADDONFIELD

Not until March, 1914, did any definite set of operating instructions appear. These instructions with modifications are sent to each operator of Imhoff tanks in the State of New Jersey and are as follows:

New Jersey Instructions for Operating Imhoff Tanks

1. *SCREENS AND GRIT CHAMBER.* If your plant includes screens and grit chamber, clean them regularly. Large floating matter or sand should not be allowed to enter the tanks.

2. *FLUSHING SEWERS.* Flush the sewerage system regularly. Remember the operation of the plant depends to a large degree on the character of the raw sewage.

3. *GREASE.* Eliminate as much grease from the raw sewage as possible. It interferes with the proper digestion of the sludge.

4. *CLEANING SIDES AND SLOTS OF SEDIMENTATION CHAMBERS.* Twice a week the walls and sloping bottoms of sedimentation chambers should be cleaned with a rubber squeegee (a flat hardwood board from 12 to 14 inches long and from 3 to 4 inches wide with rubber edges and a light wooden handle of length determined by the dimensions of the chambers) and all adhering solid matters pushed down through the slots. Floating materials, such as matches, corks, etc., behind baffles and all scum collecting upon the surface of the sewage passing through the chambers should be removed daily. This may be done by means of a dish-shaped perforated skimmer, perhaps 18 to 20 inches in diameter, attached to a long wooden handle. The scum and floating material should be buried. *Do not place it in the gas vents.*

5. *REVERSAL OF FLOW.* The flow should be reversed in direction through the tanks at least once a month. This is very desirable in order that the sludge collecting in the several wells may be maintained as nearly as possible uniform in composition and volume. Be sure to clean all floating material from inlet weir before changing.

6. *BREAKING UP AND REMOVAL OF SCUM IN GAS VENTS.* Every day the scum collecting in the gas vents should be thoroughly broken up with a rake or water jet from garden hose and pushed down into the digestion chambers. Use only enough water to loosen the scum. If this is not faithfully and consistently done at sufficiently frequent intervals scum may collect to excessive depths in the gas vents. Great depths of scum will not digest properly, and may give off more or less offensive odors of decomposition, and will eventually cause the gas-laden sludge to be forced up through the slot into the sedimentation chamber. If, in spite of frequent and thorough agitation, the scum layers become too deep, dense and hard and cannot be made to deposit in the digestion chambers, they should be removed by means of shovels. This is very important. The scum may be taken to a sludge drying bed and there covered with a generous sprinkling of lime, or if the area available is not sufficient or the scum too offensive, should be buried. If the gas vents can be connected to the sludge removal pipe, the scum can be run directly to the sludge beds. Enough water to thin it out should be added.

7. *LIME TREATMENT FOR ACID SEWAGE.* Whenever the litmus test shows an acid reaction in the raw sewage, milk of lime should be added in quantity sufficient to neutralize this acidity. The quantity of lime required will depend upon the acidity of the sewage, but unless the situation is complicated by the dumping of acid manufacturing wastes into the sewers, should not exceed 100 pounds per million gallons treated. All manufacturers found to be loading the system up with such wastes should be forced to neutralize the same before leaving their plant. The adding of lime to sludge through the gas vents is not advised. It may cause a more putrescible sludge than otherwise.

8. *OBSERVATION OF RATE OF DEPOSITION OF SLUDGE.* The rate of deposition of the sludge in the digestion chambers should be carefully watched, and the elevation of its surface should be determined twice a month.

REMOVING SCUM FROM TANK AT VENTNOR

This may be done by means of a weighted board or sheet iron plate from 12 to 18 inches square attached to a wire or cord or to a long light rod of wood lowered through the central slot. Sludge should not be allowed to accumulate to a greater depth than 1 foot below the slots.

9. *REMOVAL OF SLUDGE.* Sludge in small quantities should be drawn from the tank about once a month, in summer more frequently. The amount withdrawn at any one time should not be too great. In the first place only well digested sludge should be removed. Again, it is better, at least in large plants, to remove relatively small amounts of sludge at frequent intervals than to withdraw very large quantities infrequently. Great care should be taken not to allow the sludge *to pass too rapidly* out through the sludge withdrawal pipes because the less well digested and softer sludge nearer the surface may be forced by the water pressure out of the tank rather than the more compact, thoroughly digested and less readily flowing sludge at the bottom. Great care must be taken not to draw all the digested sludge from the tank.

10. *USE OF PERFORATED PRESSURE PIPES.* If the sludge should not flow readily through any sludge removal pipe it may be loosened by forcing clarified sewage or water through the perforated pressure pipe in the bottom of the digestion chamber, provided the tank is furnished with this device. This device in our experience is not necessary and we do not advise its installation.

11. *REFILLING OF SLUDGE PIPES.* After each withdrawal of sludge the sludge pipe should be back-filled with water or clarified sewage to avoid formation of heavy deposits. If the latter is employed it may be pumped into the pipe by means of a force pump.

12. *DRYING OF SLUDGE.* The depth of sludge deposited upon the drying bed at any one time should not be over 6 or 8 inches. In dry weather the sludge should become spadeable in a few days and should be removed from the bed. It may be used as a fertilizer upon lands or it may be used for filling in low places upon which it is not anticipated that houses will ever be built. German experience indicates that such material is a fairly satisfactory fertilizer and is well worth hauling away and utilizing upon cultivated lands. It has the advantage of being able to lighten heavy soils and it would doubtless furnish humus to soils which are lacking in this feature. When deposited in fills the thoroughly digested sludge does not undergo putrefaction and will not cause any nuisance due to odors. Do not leave the dried sludge on the bed until it is time to remove more sludge, but remove it directly after drying.

13. *RE-SURFACING OF SLUDGE DRYING BED.* Whenever the surface layer of the sludge drying bed becomes clogged, the clogged material should be removed so that the minimum depth of sand shall not be less than 6 inches and sufficient new sand be applied. This feature is important in order that water draining from the sludge may be removed quickly, either by seepage into the underdrainage system or into the naturally porous subsurface materials, as the case may be.

14. *SAMPLING AND TESTING OF SEWAGE.* The superintendent of sewers or other official in charge of the sewage treatment and disposal works should be provided with Imhoff conical glass graduates for testing the amount of suspended matter in the raw and settled sewage. Composite samples, consisting of hourly samples of the day's run, should be collected of the sewage as it enters and leaves the tank. After shaking the samples well, two Imhoff glasses should be filled, one with the crude and the other with the settled sewage to the 1000 c.c. mark. After filling, the samples should be allowed to settle for a period of two hours, glasses being rotated every fifteen minutes to free particles which have become attached to the sides. At the end of the two hour period, the volume of settled material in each glass should be read and recorded to the nearest 0.1 cubic centimeter and the percentage of removal computed by dividing the difference between the number of c.c.'s of solids in the two glasses by the number of c.c.'s of solids in the glass containing the crude sewage. The results obtained should be noted in the proper space under *REMARKS* on the monthly operating sheets submitted to the State Department of Health. Ordinarily, this test should be run once each week. From these observations the efficiency of any installation may be roughly determined.

15. *MEASUREMENT OF SEWAGE.* Every installation should be provided with a measuring weir, suitable orifices or other devices for determining with reasonable accuracy the rate of flow of sewage.

16. *RESTING TANKS.* If there is more than one Imhoff tank at your plant and one tank is causing trouble through foaming, shut this tank off and allow it to rest. Before placing it again in operation see that the surface of the settling chamber is clear of floating material.

To follow these instructions a man must be at the plant every day. Neglect to follow Nos. 5, 6 and 9 may cause foaming in the gas vents. It may not take the entire time of one man for a small plant, but there is usually enough to do in the care of the grounds or the operation of the secondary units in the treatment to keep him busy. To work at all satisfactorily, much labor of an unpleasant character must be spent on the operation.

Most of the Imhoff tanks have good supervision, the operators being intelligent if not specially trained. A marked impovement in such supervision has been noticed since Chapter 23 of the Laws of 1918 was first enforced. The law now requires that all sewage operators be licensed by the State Department of Health.

The operators at Plainfield and Chatham are trained men with considerable experience in sewage treatment. At Pitman, Oaklyn, Hammonton, Fairview and Washington the engineers who designed the plants have general supervision over the operation. It therefore cannot be said in defense of the Imhoff tanks in New Jersey that they are neglected. An example of what happens to a well operated Imhoff tank when it is neglected was demonstrated in 1918 at the Chatham-Madison plant. When the operator was in the army, sufficient care was not given the plant. The tank ceased to function as a settling tank and the effluent was at times worse than the raw sewage. Belching took place continually in the settling compartment and the gas vents were filled with floating sludge and scum. A large amount of solids were carried into the contact beds which became badly clogged.

It has, however, been demonstrated in this state that a trained operator is not always necessary for the successful operation of Imhoff tanks. At Ventnor the operator is a foreigner with about the least technical training of any of the other operators, yet the operation of the tank has been most successful. The sewage, all of which is pumped, is very stale and contains much salt water. It has a dark appearance and is septic when it reaches the treatment plant. At times during the summer there is a rapid ebullition of gas in the vents, but no noticeable amount of scum has ever formed except in the early months of operation.

(To be continued)

Lawrence's Excellent Typhoid Record

One of the earliest practical results of the experiments of the Massachusetts State Board of Health in water purification was the construction of the sand filter at Lawrence, Mass. This filter was installed in 1891, and in a year or two the typhoid death rate was diminished by 60 per cent to 70 per cent. Lawrence is a manufacturing city, with a population at present of approximately 100,000, and before the installation of the filtration plant had had a very high death rate, due chiefly to the use of polluted water from the Merrimac river.

With the use of the filtration plant the typhoid

rate has been continually decreasing, until in 1921 there were only 20 cases and one death—much the lowest record yet attained and a remarkable one for a manufacturing city of that size.

In 1892, the first year after the installation of the filter, there were 172 cases and 53 deaths. The number of deaths decreased in successive years to 44, 28, 17 and 11, then rose three years later, in 1899, to 22. From 1899 to 1911 the number of deaths fluctuated between 10 to 21. Since 1911 the number of deaths has exceeded seven only twice, being nine in 1912 and ten in 1918.

This record is the more remarkable in that some of the filter beds are still uncovered (none of the original beds were built with covers) and this, in addition to involving an expense of removing ice from and scraping the open filters in winter, presents the danger of insufficient purification in the intense cold of that Northern city directly after the scraping and resurfacing of the sand.

Refuse Destructors and Disposal in Great Britain

By C. Chambers-Smith*

Description by the editor of one of the leading English engineering papers of the present status of refuse destructors in that country. Destructors are no longer being built and some of those already built are being abandoned.

A quarter of a century ago the opinion was general among sanitarians in Great Britain that the incineration of house refuse by destructors was the only efficient and sanitary method for the disposal of town refuse. A considerable number of cities and the larger municipalities erected destructors as a consequence. But these have, for various reasons, failed to maintain the early good opinions formed of their potentialities, amongst which reasons were the heavy cost of incineration, ranging from 3 shillings to 6 shillings 6 pence per ton, pre-war; the serious initial cost of an installation; the very general failure of destructors to obtain revenue by the sale of steam generated by the furnaces, to electricity and other works as was anticipated—for electrical departments deprecated their erection contiguous to their works, contending that the machinery would be likely to be injured by dust-laden air; whilst in those cases where steam was utilized it was deemed expedient to rely upon it only to assist the electricity works over the peak load, viz: about three hours per day, the steam generated during the remaining 21 hours being consequently wasted.

Another drawback was the failure to dispose of the clinker, which amounted to 33 per cent. to 40 per cent. of the original bulk of the refuse. In some instances the clinker was crushed and used for the manufacture of paving slabs for public footways, but the supply soon outran the demand, while the cost and quality did not compare with similar materials made by private firms which specialized in their manufacture. With the exception of the Borough of Hornsey, no city, to our knowledge, has been able profitably to use the whole of the clinker produced at its destructor works, and it has been necessary to cart or barge it away at a cost in London amounting in some cases to 10 shillings per ton. Then again, destructors or incinerators could not be operated without the creation of nuisances caused by fumes or alleged fumes from the chimney shafts, whilst the continual passage of vans loaded with refuse along streets adjacent to destructors constituted an objection to them in the eyes of owners and residents of inhabited property.

*Editor of *Municipal Engineering and the Sanitary Record* (London); M. Inst. M. & C. E., F. R. San. Inst

DEMAND FOR DESTRUCTORS CEASING IN ENGLAND

It is chiefly owing to the objections thus defined that the demand for refuse destructors in Great Britain has almost ceased. For, in point of fact, the erection of a completely new installation has not been carried out for a number of years, whilst in numerous instances the operation of existing installations has ceased and the refuse is being disposed of otherwise, in some cases being barged to dumps in rural districts—a method, however, which is to be strongly deprecated as serious nuisances are caused thereby. In other cases the cost involved in the operation of destructors is now so excessive as to lead to their abolition, as was shown at a recent meeting in London of municipal engineers. The Borough Council of Hampstead has recently abolished their destructor and the engineers of the Borough of Hackney and the important urban district of Tottenham expressed their desire to see their destructors abolished.

IMPORTANT REPORT BY METROPOLITAN BOROUGH COUNCILS

The opinion expressed by a committee of representatives of Metropolitan Borough Councils and four borough engineers appointed to investigate as to the best means of disposal of refuse in the metropolis, who issued their report in December, also bears on the point. They remark that "municipalities have not adopted the destructor to any extent, indeed instances are know where, after heavy capital expenditure, this method of disposal has been abandoned; possibly owing to high cost of running, the large percentage of residual clinker, the inability to dispose commercially of the latter, and the difficulties in the way of successfully using the heat generated."

REFUSE UTILIZATION

These conditions have led a number of English authorities to investigate the possibilties of other means of refuse disposal. But it was left for the city corporation of Sheffield to take the initiative in showing other local authorities, as a consequence of experimental and research work, that town refuse contains material of considerable commercial value and that 35 per cent. of it is composed of cinders and small coal which have a calorific value equal to

that of ordinary coke. The corporation installed machinery for the purpose of separating the fuel from the general mass of refuse and of eliminating simultaneously the ashes and other fine constituents. They now use recovered fuel for direct steam raising at their public baths, whilst the surplus is briquetted with an admixture of coal tar pitch. The briquettes thus produced have a high calorific value and can be used for heating or steam raising. The revenue obtained from the separation of the various constituents of refuse, which comprise waste paper, scrap iron, bottles, rags, etc., runs into many thousands of pounds.

It must not be assumed, however, that Sheffield was the only authority which introduced "salvage methods" for, largely as a consequence of the exigencies of the war, nearly all the large towns in the kingdom undertook the sorting and salvage of house refuse, and derived considerable revenue therefrom; Edinburgh, for instance, obtaining £4073 in the year 1920-21 from salvage, whilst Glasgow obtained £6251 by the same process and other towns in similar ratio.

The Ministry of Health (London) in its last annual report comments very favorably on the advance made by local authorities in the utilization of house refuse and in the mechanical methods of separating from the refuse those materials which have an economic value. The Ministry also made reference to the crushing or pulverizing of the refuse—as is done in some districts—to fine powder for agricultural purposes, when it is inodorous, and the report of the Metropolitan Borough Committee to which we have already referred also approves of the method.

The Metropolitan Committee also indicates very clearly in their report that the sorting of refuse by specially designed machinery is, in their opinion, the best means of refuse disposal and that the great bulk of refuse can be converted into marketable commodities and sold in relief of rates.

HIGH TEMPERATURE INCINERATORS NOT A SUCCESS

It needs to be explicitly reiterated that the high temperature incineration of municipal or house refuse in Great Britain is not a success, that numerous authorities which adopted destructors have closed them down owing to the serious cost involved in their upkeep; that contemplated revenue from steam from destructor furnaces and from clinker has not been obtained. Moreover, no new destructor installations have been erected in Great Britain for a number of years past. Some form of furnace, probably of one or two cells, will, however, probably be required for the incineration of infected or filthy bedding and of infected carcasses, though the improved machinery for reducing organic waste is now very efficient and, where the quantities are sufficient, local authorities can produce high class fertilizers from condemned meat, fish, etc. Such plants are in operation at Stoke-on-Trent, Sheffield, Birmingham, Blackpool, Bradford, and many other places.

New London Turnpike—III

Distribution of materials. Obtaining and distributing water. Mixing the concrete. Equipment used.

The construction of the 33½ miles of road was divided into four nearly equal contracts, numbered from the north southward 1, 2, 3 and 4, which were operated simultaneously with independent supplies and equipment except that some of the stone and sand were furnished to more than one contract from the same source. For contract No. 1 there was established at the north end, at Glastonbury, a freight station and a 12-car cement storage shed. The stone and sand received in railroad dump cars, were hauled up an incline and dumped from a considerable height into storage piles from which hopper-bottom loading bins, filled with a clamshell bucket, delivered to trucks that distributed the sand and stone alongside the road on the subgrade. Cement was delivered in trucks and stored in piles about 45 feet apart, five of which were always maintained in advance of the mixer. The bags were piled on elevated platforms and covered by tarpaulins so that no injury was sustained by the cement in wet weather.

DISTRIBUTION OF MATERIALS

The stone for the northern half of contract 1 was delivered at the freight yard in Glastonbury in side-dump standard-gage cars, hauled over the trolley tracks, and to the top of the trestle, whence it was dumped to a 1,500-yard storage pile and later transferred by a crane and clamshell bucket to the 10-yard elevated loading hopper. The hopper, gate and chute delivered the stone into five one-batch compartments in the bodies of 5-ton automobile trucks, which transported it to the mixer.

Cement was stored in a 12-car shed at Glastonbury and was at first added to the broken stone in

Part I—Grading, unloading and storing aggregate and cost of handling stone published in January 14th issue.
Part II—Quarries, sand pits, distribution of cement and aggregate, storage bins, pumping, mixing and finishing in January 21st issue.

50-YARD STONE LOADING BIN AT COLCHESTER

STORING BROKEN STONE ON SUBGRADE

HAULING BROKEN STONE TO SUBGRADE STORAGE

the batch compartment of the trucks, but it was found that this made the load too heavy to be transported without injurying the subgrade, and afterwards the cement was hauled separately, reducing the load of the 5-ton trucks sufficiently to enable them to traverse the subgrade without injury. The bags of cement were piled on elevated platforms about 45 feet apart, covered with tarpaulins to protect them from the weather, and always maintained in advance of the mixer.

The sand for this section was excavated from a local pit alongside the road by a derrick and clamshell bucket and delivered to the mixer by trucks and teams with a maximum haul of about 2 miles. The sand was so clean, sharp and well graded that it did not require screening nor washing and passed a test of 120 Ottawa.

For the southern half of section 1 the broken stone was delivered by trucks from the Marlborough quarry with an average haul of 2 miles and a maximum haul of 4 miles. Sand was excavated from pits near the middle of the section and hauled by trucks to the mixer with only a short detour. Cement was hauled by trucks from Glastonbury a maximum distance varying from 4 to 6 miles. Cement from the 12-car storage shed at Easthampton was delivered to the mixer in trucks hauled 6 miles over a poor road and then an average distance of 2 miles over the subgrade.

The north half of contract 2 was supplied with cement from the freight yard at Westchester, with broken stone from Marlborough quarry and with local sand hauled in trucks and stone supplied by the New Haven Trap Rock Co., all hauled to the mixer by trucks. The south half of section 2 was similarly supplied from storage at Colchester.

Contract 3 was supplied with broken stone, sand and cement hauled from the freight yard by industrial trains in Colchester, and contract No. 4 was supplied with cement and aggregate, hauled by industrial trains from the New London yards and quarry. The sand for this contract was delivered into bins by derrick and loaded from elevated hoppers to the trains. Cement was also delivered by water at New London and stored in large quantities there.

The concrete mixers working south from Colchester on contract No. 3 and north from New London on contract No. 4 eventually met at Salem, where the two contracts joined, and were supplied with material delivered in 18 steel batch boxes hauled in each by four 9-car trains drawn by Whitcomb or Burton gasoline locomotives.

CLETRAC TRACTOR HAULING 3½-YARD SAND TRUCK 1,000 FEET AROUND SECTION OF NEW CONCRETE PAVEMENT AT COLCHESTER

The cars were filled conveniently through gates at the bottom of the loading hopper and were operated in 9-car trains except where the grade was so heavy that only 5 cars could be hauled. The length of the industrial tracks was limited by the length of time required for hauling, when the latter became so great as to delay the mixer. This required shifting the bins about every 10,000 feet and it was found less expensive to haul the aggregate and cement in trucks driven over the new road as far as the concrete was hard enough to endure traffic, a distance usually about 8 days behind the concrete mixer, and there dumped it on the concrete surface to be shoveled by hand into the industrial cars on the 24-inch track laid on the shoulder alongside, that delivered it directly to the skip of the mixing machine. By this method two 9-car trains with an average haul of about 4,000 feet were able to serve each mixer.

On contracts 1 and 2, where the materials were hauled over the subgrade, it was sometimes necessary in soft spots to assist the trucks with the cletrac tractor.

WATER SUPPLY

As the road was located entirely through rural districts possessing no water system, it was necessary for the contractor to supply his own water for the boilers, concrete machines, curing and other purposes and it was obtained wherever most convenient from creeks and ponds and delivered directly to the mixer through pumps that were shifted from time to time to nearer supplies as the length of the discharge pipe became longer and longer. For this service the contractor laid and relaid about 17 miles of 2-inch, 2½-inch and 3-inch pipe in sections up to a maximum length of 3 miles. An abundant supply of water was necessary to avoid possibility of interruption and to serve the steam shovels and boilers installed for the distribution work. There were therefore used six gasoline pumps, four single-cylinder driven pumps, and three duplex steam pumps, the last being found most satisfactory. The steam pumps were considered preferable to gasoline pumps on account of their greater reliability.

MIXING AND PLACING CONCRETE

The concrete was deposited between Blaw-Knox steel forms of which about 5,000 linear feet were provided. These were maintained about 500 feet in advance of the mixer and the subgrade was prepared from 300 to 400 feet ahead of the mixer at all times in accordance with the engineer's requirements.

The concrete was mixed with five chain-belt Rex mixers, three of them of 3-bag capacity being installed in April 1921, one 5-bag capacity August 1st, and another of 2-bag capacity being used to expedite the work for a few weeks.

The 5-bag mixer was loaded by trucks with end dumps, discharging directly into it and was operated by a twenty-man gang, consisting of five pavers, three finishers, two machine men, two cement men, four

sand men, and four dumping men. This machine laid from 565 to 600 linear feet of pavement daily.

The 3-bag machine supplied with materials delivered in batch boxes by the industrial cars was operated by eight men paving and finishing, four men dumping batch boxes into the hopper, and two men on the machine, making a total of fourteen men, although it was found necessary to keep an eight or ten man gang busy ahead of the mixer to do the fine grading after the shovel crew had prepared the subgrade as well as they could.

On contract 2, where the stone and sand were delivered in piles on subgrade and aggregate and cement were brough to the machine in wheelbarrows, a gang of thirty-three men was necessary and consisted of operator, fireman, four spaders, three finishers, and twenty-four wheelbarrow men, together making a progress of about 400 linear feet per day.

The finishing for one of the machines was done by hand and for the other three large machines was done by Lakewood machines which were found very satisfactory to follow up rapid mixing and produced better concrete by the thorough tamping, which prevented the honeycomb formation around the edges of the pavement. The inspectors were very rigid in exacting a mixing period of 90 seconds, actually determined with a watch, and the proportion of water was fixed by a gaged tank. Concrete specimens were taken for testing by the inspectors. Expansions joints made with 1-ply tar paper folded eight times were placed 35 feet apart. They were not, however, necessarily located at the termination of a day's work.

FORCE AND EQUIPMENT

The maximum force employed was about 700 men, who received from 30 to 35 cents per hour for labor, 45 cents for pump men and from 50 to 55 cents for engine men and machine runners. Most of the men were accommodated in ten camps maintained about two miles apart by the contractor. These camps consisted of groups of ten-man wooden bunk houses made with 8 x 12 foot detachable wall panels and two-section roofs that were quickly assembled and taken down.

The work was executed under the direction of fifteen state inspectors, one of them being stationed at every concrete mixer, one at every rock cut, one in every grading gang and one with every shoulder gang.

The principal equipment installed on the job, including that already mentioned, comprised four Ingersoll-Rand portable air compressors, six portable boilers, four ½-yard to 1-yard clamshell buckets, five chain belt Rex concrete mixers, eight derricks with Lidgerwood and Mundy steam hoisting engines, three Lakewood finishing machines, two Brown hoist locomotive cranes, one Pawling and Harnischfeger gasoline crane, one Browning crane, one Haiss and one Barber-Gren bucket loader, seven Cameron-Deane and Novo steam pumps, six gasoline pumps, twelve Ingersoll-Rand jackhammer drills, 16 Ingersoll-Rand tripod drills, two Farrel stone crushers, two Good Roads Machinery stone elevator and screening outfits, one Champion sand washing machine, one Good Roads scraper, four Buffalo-Pitts rollers, one 3-trac Tractor, three Erie and three Marion steam shovels, one saw rig, four road machines, 10,000 linear feet of industrial track, sixty industrial cars, one hundred Lakewood steel batch boxes, three Burton and three Whitcomb gasoline locomotives, four wooden hopper bottom storage bins of 10 to 40 yards capacity, one portable steel storage bin of 20 yards capacity, 10,000 linear feet of Blaw-Knox forms, fifty 12 x 20-foot standard portable camp houses, about seventy-five two-horse bottom dump wagons and forty five-ton trucks, mostly of the Mack and Pierce Arrow type, all of which were hired The trucks when running on subgrade were only able to travel about 40 miles per day, but under good conditions when running on the finished concrete road traveled up to 125 miles per day. They were kept in repair by the sub-contractors and very little delay was occasioned by breakdowns, the source of troubles occasionally encountered being usually with the hoist, most of which were of the oil cylinder and cable dump type.

During the hot weather the engineers required the concrete for 75 feet in the rear of the mixer to be protected with canvas screens on wooden frames that shielded it from the hot sun and until it had taken initial set. This protection was not required during the spring and fall, but late in the fall the fresh concrete was covered wth hay. From May 1st until September 25th the concrete was covered the second day with 2 inches of earth thrown in from the sides of the road and kept saturated for eight days.

Activated Sludge Experiments

According to a report by the U. S. Public Health Service, in its "Engineering Abstracts," in Sheffield. England, activated sludge experiments have been conducted since 1920 in a large tank so divided as to provide a continuous channel 3,544 feet long, in which circulation and activation are obtained by 18 paddle wheels, 600,000 gallons of strong sewage being treated daily. The effluent is settled in Dortmund tanks. Experiments in dewatering sludge have included the application of a vacuum to the sludge in a film on a travelling gauge band, reducing the moisture from 98 per cent. to 75 per cent. and drying on a revolving drum which dips in the sludge.

THREE-BAG PAVER SERVED BY WHEELBARROWS AT POINT THREE MILES NORTH OF COLCHESTER

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Refuse Disposal by High-Temperature Furnaces

There are few, if any, who would question the statement that the most sanitary and least offensive way of disposing of garbage and most other combustible refuse is by burning in high-temperature furnaces. There are, of course, cheaper methods, such as dumping or burying on vacant land; and to offset this disadvantage of expense the creation of steam and vitrified clinker in so-called destructors has been advocated, these by-products to be sold or utilized to advantage.

In advocating destructors for United States cities reference has commonly been made to the English practice, destructors being reported to be located in the midst of built-up sections of the cities of that country without objection and to return considerable net profit to municipalities over and above all costs of operation, this profit being derived from the sale of crushed clinker for use in concrete and for other purposes, and the sale of steam or profitable use of it by other municipal plants.

As to the last, PUBLIC WORKS has on several occasions mentioned the fact that not more than one or two destructors in this country were using steam or clinker to an extent sufficient to return a net profit, and we believe that none are doing so now; in fact, most of them do not realize sufficient to pay interest and depreciation on the amount by which the cost of a destructor plant exceeds that of one designed for complete incineration only.

Recently reports have come from England that the same has been found true of many of the destructors in that country. In order to ascertain the real condition as to this we have requested Mr. C. Chambers-Smith to give us a description of the situation at present, and this description is presented in this issue. The author is the editor of "Municipal Engineering and the Sanitary Record," probably the leading English paper devoted to municipal public works; he is a member of the "Institute of Municipal and County Engineers" and a Fellow of the "Royal Sanitary Institute," and is, we believe, fully competent to give an accurate and unbiased statement concerning the present status of refuse disposal in Great Britain. We recommend a careful reading of his article by all who are interested in this subject.

Water Users vs. Taxpayers

Is it legal, and if legal is it good business or justice to the water users, to use the surplus income of a municipal water department for helping to lower the rate of a city? As noted in last week's issue, it is reported that one of the large cities purposes to increase its water rates so as to yield a surplus and transfer this surplus monthly to the general fund of the city, if it can legally do so.

The legal right will generally depend on the state laws, city charter, etc., and must probably be decided separately for each case. But, while there may be exceptions, the decision as to whether it is good business or just to the water user would seem to be of general application.

One of the greatest difficulties in connection with the municipal operation of public utilities is securing economy in operation, and anything that stimulates a desire among municipal employes to secure more economical administration of a department should be encouraged. But what inducement is there for officials of a water department to economize if they know that any saving so effected is to be used, not for the benefit of their department but for purposes entirely disconnected therewith—possibly to permit waste in another department? It would be only human nature for those in charge of the water department to try to keep all of its income in the department. Certainly there is no inducement for economy.

As to justice, it hardly seems to us right to compel the water users to pay for other classes of city expenditures in proportion, not to the benefit they derive from such expenditures but rather to the amount of water they use. It is sometimes argued that the taxpayers and water users are the same individuals and it makes little difference whether the amount they pay for running the city is called taxes or water rent. But taxes are supposed to be based on property valuation, and if part of the water rental goes to increase the tax fund and thus is practically a tax, this tax is assessed, not on the basis of property but on that of water consumption. The scheme should rejoice the heart of the large property owner, for he thus shifts a part of his tax onto the water users of the city.

One or two cities of the country go to the other

extreme and give water "free," paying all expenses of the water department from the general taxes. This encourages waste by the consumer, but at least it favors the small property owner and compels the large owner to pay for a part of his water service, instead of favoring the more wealthy owners at the expense of the general water consumers as does the other plan.

Good Season's Record in Highway Work in Kansas

By A. A. Anderson*

Paving twenty-three miles of sixteen-foot concrete road in one season at an average rate of a thousand feet a day with two mixers, reaching a maximum rate of 846 feet with one mixer. Description of methods and plant

That portion of the Santa Fe trail located in Finney County, Kansas, and extending across the county, a distance of twenty-eight miles, is being paved with a sixteen-foot concrete surface. This work is known as Kansas Federal Aid Project No. 22.

The road follows the old route of the trail, with some modification in sharp curves and reduction of grades, passing through a flat table land and an extensively irrigated section along the Arkansas river bottom. The maximum grade is 5.7 for one short section. The sharpest curve is a 200 feet radius, on which the pavement is widened to twenty feet and superelevated ten and one-half inches. The typical cross-section is a sixteen-foot concrete roadway with six-foot earth shoulders. It has a two-to-one slope from shoulder to ditch, a two-foot ditch, and one and one-half to one on the back slopes. The maximum cut is about five feet and the maximum fill the same.

*Division Engineer, Kansas Highway Commission.

The drainage is effected entirely by open earth side ditches and by reinforced concrete box culverts from 2 ft. x 2 ft. to 4 ft. x 6 ft. in cross-section, by 18 to 24-inch corrugated metal side-road or entrance culverts with concrete headwalls, and by sumps consisting of concrete catch basins and perforated casings extending to the underflow of the Arkansas river basin. Numerous irrigation ditches are carried under the pavement by means of inverted syphons except in one case of a large ditch where the grade was raised and pavement carried over by a forty-foot reinforced concrete deck girder.

The concrete slab is of plain concrete, 6 inches thick on the sides and 7¼ inches in the center, of which the east eighteen miles is of one-course construction and the remainder of two-course construction. The old roadway was ninety per cent. ordinary earth and ten per cent. sand-clay surface. The character of the soil is such that the pavement can be

PUMP ON BARGE OBTAINING GRAVEL FROM RIVER BED AND DELIVERING IT TO SCREENING AND WASHING PLANT

laid direct on subgrade without any foundation course.

The concrete in the one-course construction is proportioned 1:2:3¼ of Portland cement, clean pit sand and gravel, screened from the Arkansas river and pits. The two-course construction is 1:1½:2½ top course, with same coarse aggregate as for the one-course except for grading, and a pit-run aggregate base. The proportion for the base course is determined by the per cent. of pit run aggregate retained on a one-fourth inch screen and varies from 1:3¾ to 1:5 of Portland cement and total volume pit run material. This produces a base of nearly uniform strength which will test not less than eighteen hundred pounds per square inch on twenty-eight day test.

The entire project was let with proposals for grading, culverts and pavement separately, or combined bids on grading and culverts, or total bid. Bids were opened on June fifteenth and July twenty-third, 1920, and the contract awarded to M. R. Amerman Paving Company of Wichita, Kansas and A. L. Cook of Ottawa, Kansas, for a total sum of $1,106,040 on unit price basis. The actual construction was commenced on the east eighteen miles in August, 1920, and the remaining ten miles in August, 1921. At the close of 1920 construction season, a large part of the grading and culvert work had been completed and a test run of 4,704 feet of pavement laid to ascertain weak points in organization and equipment layout. Active construction in 1921 was commenced on April fifth, 1921, and at the close of 1921 construction season on October fifteenth, 23.5 miles of pavement slab had been completed. The portion of the slab built during 1921 was 22.6 miles in length, of which 5.2 miles was of two-course construction.

GRADING

The grading is carried on by the two organizations, one of which consists of about forty head of stock and ten men, using an elevating grader and fresno outfit; the second consisting of about thirty head of stock, and ten men, using two-horse Mayney wheelers, snatched by a tractor. The earth is brought in from side ditches and cuts and placed in one-foot layers. It is thoroughly rolled with a 10-ton three-wheeled Case steam roller.

Fine grading is carried from one-half to one mile ahead of the mixer with a blade grader and slips, using an organization of about ten head of stock, ten men and a foreman. Upon this grade metal forms are set to true grade and alignment, and carried about four hundred feet ahead of mixer by two form setters and a helper. A total of about three thousand lineal feet of Blaw forms are used for each mixer. At the close of the work at noon and night, a Carr subgrader supported by the forms and drawn by 10-ton roller is used for leveling and smoothing the subgrade to exact grade for receiving the pavement slab.

SUPPLY OF MATERIALS

All aggregate for the pavement slab is secured locally, cement being the only material involving rail haul. A bank-run material is secured from the Arkansas river bed, screened and separated on a ¼ inch screen and reproportioned.

At first it was thought possible to secure sufficient coarse aggregate by screening all material from the river channel, using pumps. Two barges were rigged, using an eight-inch Amsco and a ten-inch Erie pump respectively, each pump belt driven by a 100 h. p. squirrel cage induction motor, using a 42-foot suction and an average of 120-foot discharge line. The pump discharged into a 10-foot rotary screen, motor driven, having about seven feet of ¼-inch mesh screen and three feet of 2-inch screen.

The material passing the ¼-inch screen with the water was flumed back to the river, sufficient sand being trapped in the flume, producing a stock pile of sand along its entire length. The material retained on the ¼-inch screen and passing a 2-inch screen was dumped into trucks ready for delivery or diverted to stock pile, while all material over 2-inch size, together with mud balls, was rejected at end of screen to a separate pile. The pit-run material as pumped contained about twenty-five per cent. of material over a ¼ inch size and limited the production of each outfit to thirty cubic yards coarse aggregate per eight-hour day. This total coarse aggregate produced, amounting to one hundred twenty cubic yards for both outfits, running sixteen hours, was sufficient to supply only one mixer.

The material supply being insufficient, upon investigation numerous dry pits were located away from the immediate stream bed. From these pits it was possible to produce fifty cubic yards per eight hour day per pit, using a gravity screen under a trap and six teams. The material in these pits furnished

ROTARY SCREEN AND FLUME PREPARING AGGREGATE PUMPED FROM RIVER BED

CRANE LOADING MOVABLE BIN FROM STOCK PILE

from thirty-five to fifty per cent. of material over a ¼-inch and under a 2-inch size.

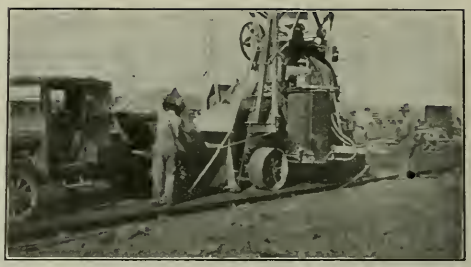
These two methods produced sufficient coarse and fine aggregate during the winter of 1920. It was delivered to stock piles on the road, involving a haul of from two to eight miles at the following approximate costs per cubic yard; sand, $3,00; coarse aggregate from dry pit, $4.50; from river plant, $4.00.

STORING AND TRANSPORTATION OF AGGREGATE AND CEMENT

The fine and coarse aggregate are hauled to stock piles and placed in separate piles at points of advantage on the road at an average distance of one mile apart. This hauling is done by the contractor's trucks and by local teamsters and truckmen on contract basis per yard mile. The sand and coarse aggregate are piled at such distance apart that both piles can be conveniently handled to a movable bin with two compartments by an Erie crane with a 32-foot boom and a ¾ yard clam shell bucket. The crane handles from three hundred to three hundred fifty cubic yards of aggregate per day. The stock piles were placed a mile apart on seventeen miles of the road, and every half mile on the balance, using a twenty-yard portable hopper. The material is loaded into the bin with a small Erie crane.

The cement is delivered to stock piles a reasonable time before using and piled on platforms and covered with tarpaulins. About fifteen hundred to two thousand sacks of cement is used per day per mixer.

The hopper of the movable bin is divided proportional to aggregate used in mix. Each compartment discharges into a separate inclined measuring box calibrated to produce the exact amount of coarse and fine aggregate for one batch. The measuring box has sufficient clearance for a truck with a one-batch body. The material is discharged into the truck body thru an end door hinged at the top.



HOME-MADE TRUCK BODIES DUMPING INTO KOEHRING PAVER

The whole operation of filling and dumping the measuring boxes takes about ten seconds, after which the truck is driven to the cement pile not over two hundred feet distant, where five sacks of cement are quickly emptied on the aggregate and the truck proceeds directly to the mixer. A total of not over one minute's time is required for the entire loading operation at plant. The organization at the stock pile consists of one craneman, one crane foreman, one bin man, five men handling cement, one general utility man and one man and team keeping material piles cleaned up and in reach of the crane.

An average of ten small trucks are ample to supply one mixer from stock pile. These trucks are of one-half ton class, pneumatic tire equipped, a single home-made frame batch box of about 25 cubic feet capacity is mounted on the truck. These boxes are hinged at the end of the car frame and in such position that the batch box can be easily dumped. The end gate of the batch boxes is attached rigidly to the frame in place so that materials have free access to come out when the box is dumped. On an average haul of one-half mile, about thirty-two batches are hauled per truck per day or an average of fifteen minutes for the entire trip.

WATER SUPPLY

In the Askansas river bottom, ample water is secured from wells twenty feet deep. Six to ten-inch well casings were driven and a four-cylinder C. H. & E. triplex pump with a 2-inch suction line supplied one of the mixers and a one-cylinder, 7½ horse power C. H. & E. triplex pump with a 2-inch suction line supplied the second mixer. One extra one-

DEEP-WELL WORKING HEAD, PUMPING FROM A DEPTH OF 120 FEET

RESERVOIR USED IN CONNECTION WITH DEEP-WELL PUMPS

FINISHED PAVEMENT COVERED BY SUN SHADES IN FOREGROUND AND BEING SPRAYED BEYOND THESE

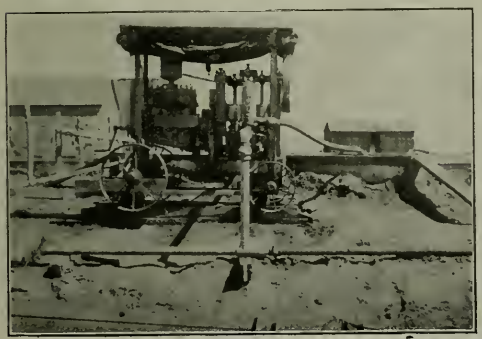
cylinder C. H. & E. triplex is kept placed on the job for emergency. A total of seven miles of 2-inch line is used to supply both mixers, water being pumped at times as far as 3½ miles.

In the hills or on high table land it was necessary to drill wells 120 feet deep. A steam driven C. H. & E. working head with a 3x36 in. cylinder, discharged thirty gallons per minute into a 15,000 gallon reservoir or supply tank, from which it was pumped to mixer with usual equipment. By pumping continually twenty-four hours, thus having full reservoir at beginning of a day's work, adequate supply was obtained for mixer and ponding.

The tanks used in storing water were made in an octagonal shape using full sheets of sheet metal 16 gauge, backed up with 4x4's; that is, the 4x4's were nailed around the top of the tank, with a post at each joint, using "Arco Sealit" to seal the joints of the sheet metal. A concrete floor was laid in the bottom of the tank, out of waste cement obtained by the sack cleaner, made just thick enough to be water tight. The tanks cost about $75 each, and were easily and quickly set up.

CONCRETING

One of the mixers was a Rex 21 E paver and the other a Koehring 21 E paver. The concrete deposited on subgrade is spread by three shovelers. It is struck off, tamped and belted by means of a Lakewood finishing machine, going over the surface not



FOUR-CYCLE TRIPLEX PUMP PUMPING WATER THREE MILES

SECTION OF COMPLETED ROAD

less than three times. The final touch is given by a hand belt operated some distance back of the finishing machine. Immediately back of the finishing, the concrete is protected by canvas covers on framework supported by the forms. When the concrete is hardened sufficiently (generally about one-half day behind the mixer), dams are thrown across and along the edge of pavement and the surface ponded.

Considerable difficulty was encountered with hair checks, especially on the windy days. Wetting the sunshades or canvas laid directly on the surface was found ineffective for preventing these hair checks. This trouble is entirely eliminated by judiciously using a fine spray of water from a hose nozzle in such a manner as to produce a heavy mist, keeping the surface moist until such time as the ponding can be carried forward.

The concrete gang includes a foreman, two truck dumpers, a mixer man, three men grading concrete, one man operating the finishing machine, one finisher and helper, one man on subgrade, two on the pumps, four ponding, four night pumpers and ponding, three men at the steam crane and bin, four at the cement storage pile, and one man sprinkling the pavement and for general utility.

PROGRESS

The progress per mixer working day was five hundred linear feet of pavement, averaging the 243 mixer working days of the 1921 construction season. A mixer day is any day in which the mixer was started, even though it was not operated the full day.

REX PAVER IN OPERATION

Some time was lost, consisting of days and part days due to water supply, rain, mixer trouble and very windy days, characteristic of this locality.

The log for period runs and the best day's run for each mixer during the 1921 season was as follows:

MIXER NO. 1

Best day's run—772 linear feet June 14th, 1921.
Best 5 days' run—3,472 linear feet as follows:

July	7th	700
"	8th	732
"	9th	668
"	11th	746
"	12th	626

Best 20 days' run—12,770 linear feet as follows:

July	6th half day	242
"	7th	700
"	8th	732
"	9th	668
"	11th	747
"	12th	626
"	13th	612
"	14th	549
"	16th	764
"	18th	691
"	19th	758
"	20th	700
"	21st	550
"	22nd	727
"	23rd	559
"	26th	585
"	27th	515
"	28th	695
"	29th	753
"	30th	608

MIXER NO. 2

Best day's run—846 linear feet, June 14th, 1921.
Best 5 days' run—3,414 linear feet as follows:

June	13th	670
"	14th	818
"	15th	575
"	16th	753
"	17th	598

Best 20 days' run—11,655 linear feet as follows:

Aug.	1st	551
"	3rd	456
"	4th	676
"	5th	733
"	6th	720
"	8th	637
"	9th	520
"	11th	530
"	12th	660
"	13th	710
"	15th	708
"	16th	710
"	17th	248†
"	22nd	289†
"	23rd	584
"	24th	568*
"	26th	659*
"	27th	608
"	29th	508*
"	30th	572*

†Water trouble.
*Square yards on curves reduced to equivalent lineal feet of sixteen-foot pavement for comparison.

PRINCIPAL QUANTITIES

The estimated quantities involved include about 149,687 cubic yards of earth excavation, 27,038 cubic yards earth borrow, 943.5 cubic yards Class A concrete, 197.8 Class C concrete, 198,136 square yards plain cement concrete pavement.

The construction is carried out by L. S. McCaslin, superintendent for M. R. Amerman Construction Company and is supervised by the Kansas Highway Commission, M. W. Watson, state highway engineer, and A. A. Anderson, division engineer. E. C. Wenger, resident engineer and his principal assistant, R. B. Wills, are in immediate engineering charge for the commission.

Mr. McCaslin has given us the following additional information:

The cement costs 80 cents a bag, delivered to the storehouse. An average of five carloads was kept stored on the road, protected by canvas. The sand and gravel cost $4.50 delivered to the storage bin. Labor received 50 cents an hour at the beginning of the work and 40 cents later; mechanics received 75 cents. The contractor used ten Panhard 1½-ton trucks and tried twenty others of miscellaneous makes.

The gravel was crushed with a Gates gyratory crusher. The screen used was made by the Road Supply & Metal Co. of Topeka. The portable loading hopper was mounted on wheels when moving, on skids when in use, the wheels being removed and replaced by the aid of the crane. Two hours were consumed in replacing wheels, moving, and putting back on skids.

Eight shallow wells were driven by the contractor by means of a sand bucket, and 6-inch casing used, the cost being about $1.00 a foot. A C. H. & E. deep well working head with 3-inch drop pipe was used for pumping the deep wells.

Benefits of Public Markets

The Department of Agriculture has recently issued a bulletin entitled "Open Types of Public Markets," which discusses the function of public markets, their ownership and control, establishment and operation, and which may be had free by writing to the Department of Agriculture at Washington. In general the bulletin expresses the opinion that:

"Open retail markets constitute the simplest and least expensively operated of all types of public markets. In its simplest form a market of this type may be merely a designated length of curb, a section of a broad street, or a vacant lot, where, under slight supervision, farmers may group their wagons and sell to consumers.

"In its highest development such a market may consist of a paved tract with raised walks covered with substantial sheds to protect teams, wares, buyers and sellers from the weather. The shed may even be of a type that in bad weather may be made practically into an inclosed building by the use of rolling doors. A few cities have erected sheds along street curbs for the protection of open markets, but for the most part curb markets are unprotected and sheds are constructed only in markets situated on special market tracts.

"The essential feature of a retail market is the restriction of purchases to consumers as distinguished from dealers. Such a market, if it is a "producers' market," furnishes an opportunity for direct dealing between producers and consumers. Open retail markets may also admit hucksters, or wagon and push-cart peddlers as salesmen. These dealers are usually admitted under certain restrictions."

NEWS OF THE SOCIETIES

CALENDAR

Jan. 30 — NEW JERSEY STATE LEAGUE OF MUNICIPALITIES. Annual meeting. Trenton, N. J.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 30-Feb. 1—NATIONAL CIVIC FEDERATION. 22d annual meeting. Hotel Astor, N. Y. C.

Jan. 31—NEW BRITAIN BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary—R. W. Sellew, Fafnir Bearing Co., New Britain.

Jan. 31 — PROVIDENCE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Narragansett Hotel.

Jan. 31-Feb. 1—LEXINGTON REGIONAL HIGHWAY CONFERENCE. University of Kentucky, Lexington, Ky.

Feb. 4-11—ST. PAUL BUILDING EXCHANGE EXPOSITION. St. Paul, Minn.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention, Cleveland. Secretary, Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' Bldg., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN ASSOCIATION OF ENGINEERS. Conference of practicing engineers. Congress Hotel, Chicago.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; April. 30, Youngstown, O.

May 15-19 — AMERICAN WATER-WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The sixty-ninth annual meeting was held January 18, 19 and 20.

At the business meeting, January 18, honorary membership was conferred on: M. Charles Prosper Eugene Schneider, Paris, France, through His Excellency, Jules J. Jusserand, Ambassador Extraordinary and Minister Plenipotentiary of France, represented by Brevet Major Dubreuil, Military Attaché to the French Embassy.

M. Schneider was presented to the president by John Vipond Davies,

M. Luigi Luiggi, Rome, Italy, through His Excellency Victorio Orlandi Ricci, Ambassador Extraordinary and Minister Plenipotentiary of Italy, represented by Commander T. F. Bernardi, Italian Consul General in New York.

M. Luiggi was presented to the president by John William Lieb.

Samuel Rea.

Mr. Rea was presented to the president by Col. William J. Wilgus.

Ambrose Swasey.

Mr. Swasey was presented to the president by Charles T. Main.

Howard A. Carson through L. H. Davis.

Mr. Carson was presented to the president by Harrison P. Eddy.

The usual business coming before the society at its annual meeting was transacted.

The following officers were elected: President (to serve one year), John Ripley Freeman, M. Am. Soc. C. E., Providence, R. I. Vice Presidents (to serve two years), Carl Ewald Grunsky, M. Am. Soc. C. E., San Francisco, Cal.; Robert Ridgway, M. Am. Soc. C. E., New York City. Directors (to serve three years), Clifford Milburn Holland, M. Am. Soc. C. E., New York City; Joseph Johnson Yates, M. Am. Soc. C. E., Jersey City, N. J.; Frank Edward Winsor, M. Am. Soc. C. E., Providence, R. I.; John Needels Chester, M. Am. Soc. C. E., Pittsburgh, Pa.; Arthur James Dyer, M. Am. Soc. C. E., Nashville, Tenn.; Walter Leroy Huber, M. Am. Soc. C. E., San Francisco, Cal.

Luncheon at McGraw-Hill Building was followed by inspection of the McGraw-Hill Publishing Company's plant. In the evening the president's and honorary members' reception was followed by a dinner-dance.

January 19, Morning Session—Society meeting. Subject, "Water Transportation." Speakers: Dr. Emory R. Johnson, dean, Wharton School of Finance and Economy, University of Pennsylvania, Philadelphia, Pa.; R. H. M. Robinson, president, United American Lines, New York, N. Y.; Winthrop L. Marvin, vice president and general manager, American Steamship Owners' Association, New York, N. Y.; Samuel O. Dunn, editor, *Railway Age*, Chicago, Ill.

For those not attending the transportation conference excursions were arranged to inspect the New York Stock Exchange in actual operation, and to visit one of the biggest foundation jobs undertaken in New York City in a long time, that of the $15,000,000 Federal Reserve Bank of New York City building, through the courtesy of the Foundation Company, as well as the Architects and the Bank Officials.

The afternoon motor bus trips visited the plant of the American Bank Note Company, where a great deal of foreign money and practically all American securities are printed.

The party was then conducted to the 240,000-kw. ultimate capacity power house of The United Electric Light and Power Company at the East River and 135th Street, where interesting construction was inspected. In the evening there was a smoker with light refreshments.

Afternoon Session—Society meeting. Subject, "Railroad Transportation." Speakers: Howard Elliott, M. Am. Soc. C. E., chairman, Northern Pacific Railway Company, New York, N. Y.; William N. Doak, vice president, Brotherhood of Railroad Trainmen, Washington, D. C.; F. A. Molitor, M. Am. Soc. C. E., chairman, Board of Economics and Engineering, National Association of Owners of Railroad Securities, New York, N. Y.; Edgar E. Clark, formerly chairman, Interstate Commerce Commission, Washington, D. C.

Evening Session—Society meeting. Address, "World Activities and Their Effect Upon the Engineer," by Frank A. Vanderlip, formerly president, National City Bank, New York, N. Y., followed by smoker.

January 20, Morning Session—"Highway Transportation." Society meeting. Subject, "Inspection." Speakers: Thomas H. MacDonald, director, Bureau of Public Roads, Washington, D. C.; Fred W. Sarr, first deputy, Commission of Highways, Albany, N. Y.; Col. William D. Uhler, M. Am. Soc. C. E., chief engineer, State Highway Department, Harrisburg, Pa.; William G. B. Thompson, Assoc. M. Am. Soc. C. E., formerly State Highway Engineer, Trenton, N. J.; Paul D. Sargent, M. Am. Soc. C. E., chief engineer, State Highway Commission, Augusta, Me.

Afternoon Session—Subject, "Financing and Bonding." Speakers: John N. Cole, commissioner, State Department of Public Works, Boston, Mass.; Robert S. Parsons, M. Am. Soc. C. E., general manager, Erie Railroad Company, New York, N. Y.; Jeremiah C. Finch, secretary, Commission of Highways, Albany, N. Y.; E. A. St. John, vice president, National Surety Company, New York, N. Y.; Edward C. Lunt, vice president, Fidelity and Casualty Company, New York, N. Y.; Frederick Stuart Greene, M. Am. Soc. C. E., formerly commissioner, Commission of Highways, New York, N. Y.; Harry Meixell, Jr., secretary, Motor Vehicle Conference Committee, New York, N. Y.

Evening Session—Subjects, "Administration," "Relation of Highway to Other Transportation Systems," "Motor Vehicle Control." Speakers: William D. B. Ainey, chairman, The Public Service Commission, Harrisburg, Pa.; Herbert S. Sisson, commissioner, Commission of Highways, Albany, N. Y.; G. Wythe Munford, inspector, Commission of Motor Vehicles, Baltimore, Md.; Harry Meixell, Jr., secretary, Motor Vehicle Conference Committee, New York, N. Y.

LEXINGTON REGIONAL HIGHWAY CONFERENCE

A conference for the study of Highway Economics and Highway Transport will be held at the University of Kentucky, Lexington, Ky., January 31, February 1, under the auspices of the University of Kentucky, the Highway and Highway Transport Education Committee of the United States Department of Education, and the Kentucky State Highway Department.

Program—January 31, 1922, Dicker Hall, University Campus, 2:00 p. m. The Relation of the United States Bureau of Education to Highway Development, by Dr. John J. Tigert, United States Commissioner of Education, Chairman Highway and Highway Transport Committee. The Future of Highway Transport, by E. S. Jordon, President Jordon Motor Co., representing the National Automobile Chamber of Commerce. Recent Developments in Highway Engineering Research, by Dr. W. K. Hatt, National Research Council.

Discussion.

Informal Dinner, Lafayette Hotel, 7:00 p. m. The Purpose of Highway Development in the United States, by Thomas H. McDonald, Chief of the Bureau of Public Roads, U. S. Department of Agriculture. Kentucky's Road Problem, by Joe S. Boggs, State Highway Engineer. The Scope and Purpose of Federal Aid in Behalf of Improved Highways and its Relation to the States, by Hon. John M. Robison, Member Congress, 11 District Kentucky. The Farmer and Good Roads, by J. M. Feltner, Member Agriculture Extension Division, University of Kentucky.

Discussion.

February 1, Dicker Hall

February 1. Possibilities of Maintaining Lower Cost Surfaces, by W. N. Bosler, Principal Assistant State Highway Engineer of Kentucky. Safety First Education in the Public School, by Miss Harriet Beard, Supervisor of Safety Education, Detroit, Mich. The Uses of the Highway, by Dr. J. G. McKay, University of Wisconsin. The Training of Engineers for the New Highway Building Program, by D. V. Terrell, Professor of Civil Engineering, University of Kentucky.

Discussion.

Report of Resolutions Committee.

CHICAGO ROAD BUILDERS' CONVENTION AND GOOD ROADS' SHOW

The Road Builders' Convention and Good Roads' Show, held in the Chicago Coliseum, January 17-20, had an unprecedentedly large attendance from all parts of the country and developed earnestness and enthusiasm for the best methods of financing, designing, constructing and maintaining highways, and for the materials, plant and equipment necessary for the best results. The exhibits were numerous, important and well presented, and the technical features of the convention were emphasized by the arrangement of the program so as to concentrate and classify principal interests in separate sections, which were devoted to Bituminous roads, Portland cement concrete roads, Common roads, Highway finances, Highway traffic and Transportation, and Highway research, all of which were conducted with special papers by experts as enumerated in the program published in PUBLIC WORKS January 14, page 36, and amplified and vitalized by the discussions by the practical and theoretical road builders present.

The congress opened in the Coliseum with more than 10,000 delegates in attendance. Among them were governors of 48 states and mayors of 4,730 cities and towns, either in person or represented by an official delegation. All Canadian provinces were represented and builders from all of the island possessions of the United States were also on hand.

A feature of the opening session was the personal message that Col. H. L. Bowlby, president of the American Road Builders' Association, brought from President Harding to the delegates, saying:

"There is now pretty nearly universal agreement that no single public improvement has done in recent years, or will do in coming years, more for the general good of the country than the development of our highway system. The task is an enormous one, but better methods both in physical construction and in the relations of the community to highway development have been taking form in a most encouraging way.

"Your organization has been a chief contributor in this direction, and it is with much pleasure that I ask you to extend to its members my best wishes for their continued success."

Letters were also read upon the opening of the convention from Brig.-Gen. Charles E. Sawyer and United States Senator Lawrence C. Phipps, of Colorado.

The congress program for the first day included an address of welcome by Mayor Thompson, an opening address by Col. Bowlby and a general discussion of highway paving types.

Col. Bowlby told the congress that the advent and development of the American Road Builders' Association has had much to do with making the industry what it is. He described its growth since organization in 1902 and asserted that the assocation could be made the most potent influence in highway development in this country, if not in the world.

Among the important resolutions presented to the convention was one endorsing 20 feet as the standard minimum width for laying highways principally because in addition to occupying space actually needed for traffic, the shoulders of narrow concrete roads are much more badly damaged by heavy vehicles overrunning on them, which also jeopardize the edges of the concrete which is likely to be much more broken than when the traffic is retained within a foot of the edge. The increased width of Bituminous roads will also tend strongly to prevent the development of ruts that are found in narrow roads.

It was generally admitted that the 18-foot standard is not only inadequate for present conditions, but is much too small for future traffic. A. W. Dean, chief engineer of the Massachusetts Highway Department, stated that Massachusetts is now specifying a 20-foot standard for main highways and preparing for 26-foot roads, as on the Boston Highway where the foundation is 26 feet wide, although the present wearing surface is only 20 feet. In districts where not more than 200 or 300 vehicles pass daily, 18-foot width suffices unless the traffic is chiefly of motor trucks. Motor trucks 8 feet wide overall are now in service on many highways and two of them cannot safely pass on an 18-foot roadway.

James H. MacDonald, former state highway commissioner of Connecticut, advocated for main highways a minimum of 20 feet travelway with a 5-foot ditchless shoulder on each side.

Frank H. Terrace, president of the Washington State Good Roads' Association, stated that although the cost of clearing and grading was sometimes very high in Washington, so that in certain localities it was necessary to restrict the road width to 16 feet, they made them wider wherever possible, and have constructed them up to 26 feet in width, and provide a right of way of 60 feet for all roads.

Alfred Dryland, engineer of Middlesex, England, was quoted as saying that within a few days he had ridden over more dangerous roads near New York than he had in England during 40 years, that the roads were dangerous on account of their narrowness and that the minimum width of pavement should be 30 feet, adding that if American traffic continues to grow, roads 150 feet wide, such as now exists between London and Edinburgh, will be required on American main trunk highways and especially near large cities.

E. D. Smith, of the United States Bureau of Public Roads, advocated a minimum width of 20 feet and stated that bridges were now recommended to be 22 feet and whenever possible 24 feet in width.

J. E. Pennybacker, former chief economist of the U. S. Bureau of Public Roads, and secretary to the National Association of Asphalt Producers, endorsed the demand for wider roads on account of the enormous increase of traffic, which when considering both vehicles and speeds on country roads amounts to 3,000 per cent. during the last 12 years. Although there is more paved surface there is little increase in actual mileage, and in order to handle the traffic there must either be one set of roads for fast and one for slow moving vehicles,

or the roads must be built wide enough to care for both. In large American cities the heavier travelled streets are in better condition than the intersecting and seldom travelled streets.

J. H. Mullen, chief engineer of the Minnesota Highway Department, announced that Minnesota has adopted a 20-foot standard for all roads in suburban districts and 27 feet for roads in congested districts and an 18-foot paved surface for little travelled 30-foot roads.

Mr. MacDonald was in favor of the construction of a 10-foot paved surface on one side of the center of a country road where traffic is light, to provide one traffic lane until requirements demand that it be widened for two lanes.

Prof. Arthur H. Blanchard, of the University of Michigan, urged a 20-foot minimum standard width as sane, efficient and entirely capable of handling traffic demands ordinarily made on the average well travelled country highway.

Major W. A. Welch, chief engineer of Palisades Interstate Park Commission, of New York, favored wider roads as a necessity for present traffic conditions, not only to give greater clearance for moving vehicles, but also for vehicles parked alongside the roadway which encroach seriously upon it. On the other hand he considered that too wide roads are death traps, because a 27-foot roadway permits cars to pass three abreast, making a danger zone in the middle of the road. A 20-foot roadway with a 5-foot shoulder on each side is sufficient clearance without being too wide for safety.

M. O. Eldridge, director of roads of the American Automobile Association, pointed out that the increase of automobiles from 700,000 in 1911 to 10,000,000 now, demands wider roads that will last longer and cost less for upkeep than narrow ones.

C. M. Upham, chief engineer of the North Carolina State Highway Commission, and secretary of the American Association of State Highway Officials, favored 20-foot standard on all main lines and other lines with dense traffic, and stated the cost of shoulder maintenance of an 18-foot roadway when added to the cost of the roadway itself greatly exceeds the cost of a 20-foot road and its maintenance. The width of the road should be increased with the increase of traffic, allowing at least 10 feet for each lane of traffic.

Resolved, That the American Road Builders' Association heartily endorses the action of Congress in adopting a policy of federal aid for highways to be applied to a definite system of highways as provided in the Federal Highway Act which went into effect November 9, 1921.

We pledge our hearty and unqualified support to the Federal Bureau of Public Roads in carrying out the provisions of said act.

Inasmuch as the act contemplates continued federal participation with the states in highway improvement, we realize and emphasize the absolute necessity of a definite policy projected far enough into the future to make possible the economic and satisfactory planning and carrying out of the intent and purpose of the act.

To this end we endorse R. R. 8978, introduced by the Hon. Roy Woodruff, which bill authorizes the appropriation of $100,000,000 annually for five years beginning July 1, 1922, as a general federal aid appropriation, and we also urge that adequate provision be made in the said bill for the continued development of highways in and adjacent to the National Parks, forest areas and Indian reservations and the Territory of Alaska under unified control.

The adoption of this five year program is necessary to enable the states, through their legislatures, to make proper provisions for the requisite state cooperation in this enterprise.

Resolved, That the American Road Builders' Association urges upon the Interstate Commerce Commission and upon the various state railroad commissions (or equivalent state bodies) the importance of a review and comparison of the present rates on road materials and on other commodities, to the end that present existing inequalities may be removed and the taxpayers' interests protected.

Resolved, That the American Road Builders' Association pledges itself collectively and as individuals to use its best efforts to speed up the properly planned elimination of grade crossings, to the end that all of them, especially on the main traveled highways, shall be eliminated as rapidly as funds can be made available by the public and the railway companies.

Resolved, That we condemn, as against public policy, the present attitude of negation adopted by too many railroad companies and by too many state railroad commissions; because such attitude has resulted in the slackening of elimination work at a time when the protection of the traveling public is much more urgent than ever before.

Resolved by the American Road Builders' Association in convention assembled, that the efforts by the various committees that are now working to solve the problem of finding a method of stabilizing subgrades and completing the study of the relationship of subgrade to traffic and road surfaces should have the hearty support of this association, and that every assistance be rendered from whatever source to speedily assist in solving this problem.

Whereas, It has come to the attention of this Association that "Public Roads," the monthly magazine of the Bureau of Public Roads, has been indefinitely suspended together with other government periodicals, and

Whereas, "Public Roads" is a necessary medium to disseminate the results of highway research and for the interchange of opinions and ideas between the U. S. Bureau of Public Roads and the Highway departments of the several states in connection with the administration of cooperative highway construction under the Federal Highway Act.

Resolved, That the American Road Builders' Association endorses "Public Roads" as heretofore issued, and urges that its publication be immediately resumed.

Resolved, That the American Road Builders' Association pledges its support to any proper movement to eliminate advertising signs along or adjacent to public highways and urges upon its individual members the importance of aiding and encouraging legislation in all states to effect said elimination, to the end that our highways may be fully and safely occupied and enjoyed by the public, for the use of whom they are acquired and built.

Resolved, That this organization pledges itself to work for efficiency and permanency in the personnel of all departments engaged in highway improvement for the elimination of partisan politics from the operation, and for the reward of ability wherever found.

Resolved, That the American Road Builders' Association welcomes the establishment by the National Research Council of the Advisory Board on Highway Research and that the Association pledges its support to the Advisory Board in this much needed effort to stimulate and co-ordinate highway research.

Resolved, That the American Road Builders' Association, assembled in Chicago at its 19th annual convention, petition the President to take such steps as may be necessary for the Government of the United States of America to become a member of the International Road Congress.

Whereas, It is the experience of road engineers that eighteen foot pavement widths carrying dense traffic in the vicinity of large cities are not adequate,

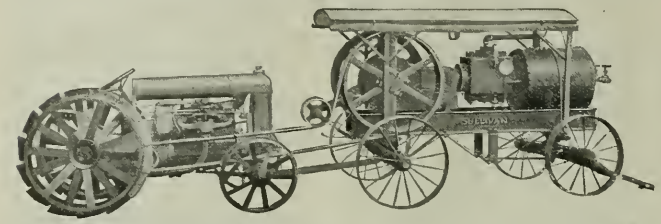
Resolved, That the American Road Builders' Association go on record as favoring a pavement width of not less than twenty feet for all trunk highways or roads carrying dense traffic.

Resolutions of thanks to Col. H. L. Bowlby and to the United States Bureau of Public Roads were carried.

From the standpoint of the exhibitors the road show has been a success, Lieut.-Col. H. L. Bowlby, president of the association, reported, when more than $2,000,000 in sales had been recorded.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



PORTABLE AIR COMPRESSOR, WITH TRACTOR IN OPERATING POSITION

PORTABLE AIR COMPRESSOR OPERATED BY TRACTOR

The Class WK-34, portable belt-driven air compressor, manufactured by the Sullivan Machinery Co., is a standard 8 x 8-inch straight line belt-driven air compressor with a displacement capacity of 121 cubic feet of free air per minute and designed to run 250 rpm and furnish air at 90 pounds pressure. It is intended to be belt driven from a tractor which will need to transmit about 18 h.p. to operate the compressor to its rated capacity. The compressor is mounted on a steel truck having wheels with a wide face and a 4-foot 8-inch track gage, and weighs about 4,100 pounds.

The compressor is designed and operated by a Fordson or other similar type of tractor, to which it is attached by a distance piece or connection bar for the proper belt tension when in service. The same tractor that operates the compressor is used for hauling it from place to place, in which case both the tractor and the compressor are reversed, end for end, from the operating position shown in the engraving.

WOOD HYDRAULIC HOIST AND BODY

The 2-yard garbage body, type G-25, is built special by the Wood Hydraulic Hoist and Body Company, to conform with city laws and ordinances and is shipped complete, ready for attaching. It has been necessary to develop this special type of body for handling garbage because there is considerable liquid contained in the garbage, and because garbage tends to slide from the body in one compact mass. It is difficult to use a hinged tail gate on a garbage body, as the gate must be watertight. Therefore the rear end of the body floor is inclined or tapered for the full depth of the body, thus eliminating complicated tail gate mechanism.

The inclination at the end of the body is approximately 20 degrees, an angle which will allow a sufficient slope when the body is fully elevated so that the body contents will slide out freely. Garbage bodies must be equipped with some form of covering to hide the unsightly load and prevent spilling of some of the contents. In some cases, hinged steel covers, made in sections so as to be absolutely tight and easily operated and to uncover only a portion of the body at a time, are used. The rear end hinged covers are arranged to open and allow the load to discharge when the body is elevated.

Another widely used form of covering consists of canvas tarpaulin rolled on a stick or rod. As the body is filled, the tarpaulin is rolled back to cover the load and tied down tightly to hooks or rings on the body sides. The tarpaulin cover is easily operated and will adapt itself to inequalities of the body load. The tarpaulin is easily handled, is not subject to mechanical defects and will be free from the noise or rattle of the hinged steel covers on an empty body.

This garbage body is widely used by Municipalities and is manufactured in smaller sizes for the Ford one ton truck and for the Reo speed wagon. These smaller garbage dump trucks are very popular with Municipalities, their short wheel base adapting them particularly for service in narrow and winding alleyways.

The same company produces the Wood-Detroit Vertical Hydraulic Hoist and the Horizontal Hydraulic Hoist and has developed a new Under Body type, now in production, for the smaller vehicles such as the Ford, Reo and light one ton trucks.

GARBAGE BODY WITH VERTICAL HOIST

GARBAGE BODY WITH HORIZONTAL HOIST

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 NEW YORK, FEBRUARY 4, 1922 No. 5

Constructing Detroit Filter Plant

Equipment for handling and storing aggregate and mixing and placing about fifty thousand yards of concrete.

The municipal filter plant and coagulation basins for the city of Detroit has a concrete superstructure supported on about 15,000 Raymond concrete piles. It occupies an area of approximately 500x800 feet and contains about 48,300 cubic yards of concrete in walls, floor, and roof which are reinforced with about 2,200 tons of steel rods. About 9,500 yards of earth excavation was necessary. The contract for the superstructure was awarded to the Thompson-Starrett Co., which commenced operations last May and completed all of the work November 15th. During last summer they employed a maximum force of 300 men.

RECEIVING AND STORING MATERIALS

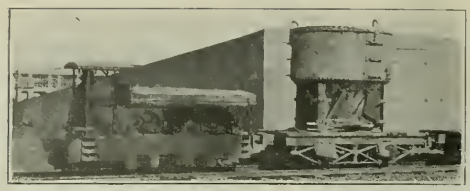
There was required in all about 75,000 tons of sand and gravel, received in boats, unloaded by a Brown 35-ton locomotive crane and 1 1/4-yard clamshell buckets, which deposited it in stock piles of about 500 yards capacity, whence it was reclaimed by the crane that delivered it as used to a 200-yard hopper-bottom elevated loading bin, from which it was chuted by gravity to the charging hoppers of two one-yard Smith mixers. The same crane also unloaded cement delivered in boats, which was stored in a shed of 30,000 bags capacity having hatchways in the roof to receive cement skips. The locomotive crane was operated by one man and a fireman and had a capacity of 700 yards of material handled in eight hours.

There were required for the work about 300,000 bags of cement. In removing the cement from the shed, the bags were loaded by hand on skips, which were moved by jacklift trucks 50 feet to a platform elevator which delivered the skips to the charging floor of the concrete mixing tower where a similar truck transported the skips to the charging hopper.

MIXING AND DISTRIBUTING CONCRETE

The mixer was set about 20 feet above the surface of the ground and discharged into a 5-yard hopper with a bottom gate through which the contents were delivered to special 5-yard buckets on flat cars hauled by a Plymouth gasoline locomotive on an industrial track about 1,000 feet long, by which the buckets of concrete were delivered to trolley hoists on a pair of travelling cableways of 1,000 feet span which served the entire area of the work under construction and enabled the concrete to be deposited in the forms at any point at an average rate of about 100 yards per hour. The minimum time required to load, transfer,

PART OF CONCRETE FOUNDATION PILES DRIVEN. ONE SECTION OF WALL FORM SET AND TWO 1,000-FOOT CABLEWAYS INSTALLED AT FILTER BED



SPECIAL 5-YARD CONCRETE BUCKET HAULED BY GASOLINE LOCOMOTIVE

dump and return the 5-yard buckets was about 5 minutes.

SPECIAL CONCRETE BUCKETS

The 5-yard buckets were of special construction, about 5 feet in diameter and 8 feet high, with conical bottoms closed by horizontally moving steel gates and weighing about 4,000 pounds empty. They were suspended from the trolley hoists of the cableways by three-part bridles and were found very convenient and satisfactory in use, the slot openings in their conical bottoms enabling the concrete to be deposited with accuracy and rapidity in narrow forms.

CABLEWAYS

The two Lidgerwood cableways were suspended between timber towers about 110 feet in height and operated on seven parallel lines of rails at each end of the filter basin. Under each tower there were two standard gauge tracks 38 feet 8 inches apart on centers and a three-rail track 49 feet 6 inches from one of the standard tracks. Each set of tracks carried two head towers or two tail towers. The tail towers were traversed the full length of the 600-foot tracks by a 50 h.p. double drum stationary hoisting engine with an electric motor operated by 220 volt, three-phase, 60-cycle A. C. current. Each of the special drums operated an endless cable, which hauled one of the towers back or forth according to the direction at which the reversing drum was operated; each end of each cable operating an anchored tackle arranged as shown in the diagram plan. The head towers were similarly traversed by engines installed in the towers. The cableways were traversed at a speed of about 100 feet per minute and the buckets were hoisted and traveled on the cableway at a speed of about 1200 feet per minute by a 12x12-inch Lidgerwood cableway hoist operated by a steam engine and a 160 h.p. boiler installed in the base of the head tower.

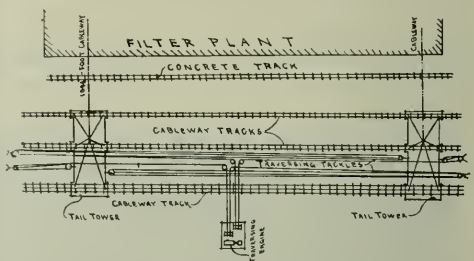
CONCRETING WALLS

The wall footings were generally from 12 to 20 feet wide and 6 feet thick. They were concreted in sections about 60 feet long, with the sides bevelled and recessed to engage the floor slabs and to form skewbacks for the floor inverts. The lower bent ends of the wall reinforcement rods were imbedded in the footings and projected several feet above the surface to bond with the wall concrete.

Wall concreting was carried on at six different places simultaneously, the walls being made in sections about 60 feet long cast in wooden forms made with heavy panels for each side. They were handled by the cableway hoists and were bolted together with horizontal through tie bolts bearing on three tiers of rangers. The end panels were similar to the side panels except that their dimensions were smaller.

The ground between the wall footings was trimmed and brought to smooth accurate surface at subgrade, the horizontal reinforcement bars were put in position carefully supported in the proper horizontal planes and wired together at occasional intersections. The cast iron collection pipes were assembled in position, supported on permanent concrete pillows and their lower portions were imbedded in concrete which was carefully rammed in position, screeded and troweled to the required upper surface. The flat roof was concreted in wooden forms supported by the division walls and by vertical shores with wedge adjustments.

The work was built under the direction of the Board of Water Commissioners of the city of Detroit, George H. Fenkell, general manager and Theodore A. Leisen, civil engineer.



TRAVELING TOWERS AT ONE END OF CABLEWAY

Typhoid Fever in Detroit

It is reported by Dr. F. M. Meader, of the Detroit department of health, that a survey of 247 cases of typhoid fever which occurred in that city in June, July, August and September, 1921, showed that 43 cases, or 22.4 per cent apparently received their infection while bathing in the Detroit river. Some of the data which gave most probability to this conclusion were (1) the temperature of the air; (2) the presence of contaminated water and the location of these cases adjacent to this water; (3) the amount of bathing done in this water during the period when the patient was infected, and (4) the exclusion of other known sources of infection.

Bathing as a cause of typhoid fever has not often been considered an important feature or been included prominently in surveys made of typhoid epidemics, and this case is of special interest for this reason.

Vanderbilt Village

A village was founded by the late George W. Vanderbilt on his estate near Asheville a number of years ago and was passed on to his heirs as a privately owned village. Less than two years ago it was purchased by a realty company. On January 1 of this year the city's commissioners, acting upon a petition from the citizens, purchased the water, sewerage and lighting systems serving the town from the development company. This town was laid out to be an ideal village, experts having been employed to plan it and design and construct its utilities.

Amount of Street Sweepings in St. Louis

Amounts picked up by suction sweepers during five years. Amount removed just after a rain greater than from the same area at other times.

About five and a half years ago an arrangement was made for the sweeping of the streets of the shopping section of St. Louis by a suction sweeper by the Way-Cleanse Corporation, the area swept being about 176,000 square yards the first year and about 297,500 the last three years. Sweeping was done by night, the machines operating over the entire area every night except Sunday and stormy nights, the number of nights per year varying from 232 to 259.

The amount of dirt removed is measured and weighed and the records are probably more accurate statements of the amount of dirt removed than are those of most street cleaning departments. Moreover, it is believed that they more correctly represent the amount that collects on the pavements, for the suction sweeper is believed to collect the dirt more completely than does a broom, just as a vacuum cleaner obtains more dirt from a carpet than does a broom and dust-pan; while in the case of a street flusher a considerable part of the dirt is washed into the sewer.

The figures for the past five years have been furnished to us by the Way-Cleanse Corporation, and will be extremely interesting to municipal engineers. They are as follows:

Two sweepers swept the same section during the year from Jan. 1 to Dec. 31, 1917, a total of 248 nights, 43,670,551 square yards; they picked up and hauled to the dump, 3,224,177 pounds of dirt and dust, or an average of 13,000 pounds per night, or 738 per great square.

Between Jan. 1 and Dec. 31, 1918, two sweepers swept the same section each night for 232 nights, 54,843,152 square yards; they picked up and hauled to the dump 3,448,300 pounds of dirt and dust, or an average of 14,863 pounds per night, or 629 per great square.

Between Jan. 1 to Dec. 31, 1919, two sweepers swept the same section each night for 259 nights, 77,077,749 square yards; they picked up and hauled to the dump 5,194,496 pounds of dirt and dust, or 20,056 pounds per night, or 674 per great square.

Between Jan. 1 to Dec. 31, 1920, two sweepers swept the same section 235 nights, 69,941,526 square yards; they picked up and hauled to the dump 4,982,-904 pounds of dirt and dust, or 21,204 pounds per night, or 712 per great square.

Between Jan. 1 to Dec. 31, 1921, two sweepers swept the same section 233 nights, 59,658,606 square yards; they picked up and hauled to the dump 4,929,620 pounds of dirt and dust, or 21,157 pounds per night, or 826 per great square.

An examination of the above statement for five years of sweeping over the same section will show that the daily amount of accumulation per 1,000 square yards is almost constant.

To determine the nature of the dirt that was picked up by the sweepers an analysis was made by the city chemist's department. The amount of sweepings used for the purpose was 5,256 pounds, which was placed in three kettles burning five hours at 800 degrees F. The loss was 26.60 per cent. of combustible matter. Of the remaining 3,858 pounds there was 60.20 per cent. passing a 200-mesh screen; 12 per cent. passing an 80-mesh screen; 1.20 per cent. passing a 40-mesh screen; 0.00 per cent. retained on a 10 mesh screen. Total, 100 per cent.

Another peculiar feature experienced was that after a heavy rain the machine sweeping the center of the pavement always picked up from one-half to one cubic yard more than was picked up from the same section the previous night or the night after. For instance, on June 23, 1916, it stopped raining at 4 P. M. The machine started to sweep at 8:15 P. M. The load picked up from 16,035 square yards was 3.92 cubic yards.

On June 24, 1916, sweeping the same 16,035

HEAD TOWER FOR NO. 1 CABLEWAY, DETROIT FILTER PLANT

TRANSFERRING SAND AND GRAVEL FROM STOCK PILE TO LOADING HOPPER

square yards, the load picked up was 2.18 cubic yards.

July 3, it stopped raining at 9 P. M. The machine started to sweep at 1:30 A. M. The load picked up from 16,035 square yards was 3.19 cubic yards.

July 4, 1916, sweeping the same 16,035 square yards the load picked up was 2.11 cubic yards.

July 19, 1916, there was a heavy rain from 1:30 to 3 P. M. The weather bureau reported .81 inches of rain. The machine started to sweep at 7:30 P. M., and the load picked up from 16,035 square yards was 3.18 cubic yards. July 18, 1916, sweeping the same 16,035 square yards, 2.78 cubic yards was picked up.

The center sweeper, as it is called, sweeps all but nine feet on each side of the pavement. This is swept by the machine confined to sweeping the gutter.

We meet the same conditions in all cities where the sweepers have been demonstrated. Can any one who reads this account for this increase of dirt after a heavy rain?

City Planning for Asheville

Asheville, N. C., is believed to be the first city in that state to adopt a full city planning method and is one of few cities in the South to do so. It has already taken steps towards a definite planning program, this including the appointment of a city planning commission and securing the services of an advisor on city planning.

Operating Filtration Plants

Too little attention is paid by most small cities to the maintenance and operation of their filter plants, in the opinion of Mr. Hinman, and he gives some excellent general advice as to plants requiring special attention by filter operators.

In a paper before the Iowa Engineering Society entitled "Water Purification in Iowa," Jack J. Hinman, Jr., of the State University of Iowa, outlined comprehensively, but briefly, the condition throughout the state as to the kind and nature of the water purification plants, the character of the water in respect to necessity of purification, etc. Eleven of the plants use chlorination without other treatment, two are for iron removal, eighteen are filtration plants for removal of bacteria and turbidity, and two are coagulation and sedimentation plants for the same purpose.

Mr. Hinman calls attention to some of the defects in the construction and operation of the plants. A few he describes as being quite antiquated and inadequate, while others are apparently well designed and modern. "In a few cases there appears to be insufficient capacity of settling basins. Somtimes, as at Iowa City, a clear well is so small that the rate of filtration is subject to excessive variations throughout the day and night."

"In general, the greatest defect in the operation is the tendency to slight the filters, and devote extra attention to the pumping machinery. The opinion of the operating force is too often that the running of the pumps comprises practically the whole job. The laboratory equipment supplied at the time of the installation of the plant is too often used only for the collection of dust. Analyses at the state laboratories are in many cases too infrequent, and the plants are run for long periods without any definite knowledge as to how they are functioning or as to the quality of the effluent. Daily analyses are the rule at Cedar Rapids, Council Bluffs, Davenport, Iowa City and Oskaloosa. Frequent analyses are made at the state water laboratory on the supplies of Burlington and Keokuk. The occasional analyses made at the other plans vary from work of similar scope through simple alkalinity and turbidity determinations to practically nothing. Des Moines makes daily tests upon the water of its chlorinated infiltration gallery supply.

"The variation in the effluents of plants which are carefully watched from day to day, is such as to indicate that unless there is some way of quickly spotting inadequacy of the treatment in use, so that suitable changes may be made, unsatisfactorily purified water may be supplied for long periods."

"Practically all of the plants have given one or more unsatisfactory results when examined at the water laboratory at the State University. In fact, only one plant has not been found to yield such a result when so examined, and that plant, which has supplied the state laboratory with few samples, is known to have furnished unsatisfactory results when examined locally by the health officer. It should be mentioned, in fairness to the operators of all the plants, that some of the samples were sent in to the laboratory at times when something was going badly at the plant, and there was fear as to the quality of the effluent. However, enough samples have been analysed to show that even a carefully watched plant may occasionally, especially under unusual or difficult conditions, yield an unsatisfactory water."

Mr. Hinman then gave some general advice as to the points which should be given special attention by the operator of a filtration plant, which we give in full herewith:

"In studying the character of a water supply there is no point which is more closely watched than the presence of gas-forming bacteria when the water is planted into lactose broth. The raw water which is treated in the plant is usually known to have suffered sewage pollution at some time in its history. These gas-forming organisms, certain ones of which are of value as indicating the presence of sewage-like material, give the analyst his chief clue as to the

adequacy of treatment and the safety of the supply. Bacterial counts show the relative efficiency of the removal of the organisms from all sources. The presence of the typical sewage organism, bacterium coli, in different quantities of water is largely depended upon to give the analyst an idea of the extent to which sewage and pathogenic bacteria have been removed.

"The bacterium coli, being a hardier organism than certain pathogens, such as the typhoid organism, may be presumed to survive after their deaths. The freer the water is, therefore, with respect to bacterium coli, the greater its safety. The bacterium aerogenes, closely related to the bacterium coli, is, like the latter, found in sewage. It is also associated with grain, and the soil, and other sources of a nature less objectionable than human sewage. This organism may survive after the removal of the colon type, but its presence in a filtered water is regarded as little less significant than that of its relative.

"There are also certain gas-forming bacteria found in soil, sewage, and elsewhere, which are especially resistant to treatment because of their ability to form spores. These spores can resist chlorine in all practical amounts, and can in some cases survive the boiling temperature for several minutes at least, Since these bacteria are so much more resistant than the pathogens which cause intestinal disorders, finding these spore-forming organisms in a water, particularly in the larger quantities tested, can not give us information of the same value as the presence of the bacterium coli in determining adequacy of treatment. We would, of course, prefer not to find the spore-formers, but whatever significance their presence has in a supply is limited to their own possible character as pathogens. Experience would indicate that in connection with water borne diseases, the possibility of their being able to produce intestinal infections is very remote.

"It has been our practice to class these spore-bearing gas-forming as a typical gas-forming bacteria. Usually the atypical forms, as distinguished from bacterium coli, and bacterium aerogenes, constitute the greater number of gas-forming organisms found in our filtered, chlorinated water in Iowa. Most of the atypical forms refuse to grow aerobically on the confirmatory plates. Any attempt, therefore, to judge the quality of the effluent of a filter plant by unconfirmed tests for gas-forming bacteria is likely to be unfair to the supply in question, although the error would be on the side of safety.

"In connection with the study of the gas-forming organisms in our filtered waters it is instructive to note the number of times that bacterium coli, bacterium aerogenes and atypical gas-forming bacteria were found in the water samples from plants listed in Table No. 3. A casting up of the numbers of tubes gives the following results:

Tubes showing bacterium coli	391
Tubes showing bacterium aerogenes	85
Tubes showing atypical gas-formers	1,902
Tubes showing no gas formation	8,188
Total number of tubes	10,566

"In this series there were about four atypical gas-formers for each positive test for the bacterium coli or the bacterium aerogenes.

"In an attempt to learn something of the vitality of these atypical gas-formers, the writer took a culture of one of them, obtained from a water, together with a sample of raw water obtained from the same source. Ten cubic centimeters of the raw water and three or four cubic centimeters of the broth culture were added to separate tubes of lactose broth which had been heated to 80 degrees Centigrade. After planting, the tubes were maintained at that temperature for five minutes. The process was then repeated with fresh quantities of water and broth culture, holding the newly planted tubes at about 100 decrees Centrigrade for five minutes. The tubes were then placed in an incubator at 37 degrees Centrigrade and observed for gas production, as in the ordinary procedure in testing for the bacterium coli. The original culture was also submitted to the boiling temperature for five minutes and incubated in the same manner. The results of the test are indicated in Table No. 4:

Table No. 4

Culture.	*Gas Formation.*			
	24 hrs.	48 hrs.	72 hrs.	96 hrs.
Original culture	30%	70%	75%	75%
10 c. c. raw water, 80° C	0	10	30	70
do	0	10	30	70
3 or 4 c.c. original culture, 80° C.	8	8	8	10
10 c. c. raw water, 100° C	0	60	80	80
do	0	Trace	10	20
3 or 4 c. c. original culture, 100° C	10	10	20	30

"From such a showing as this, one is justified in saying that these particular organisms are very resistant, at least as far as heat is concerned. They also showed great resistance to chlorine. A relatively high chlorine dosage had comparatively little effect on them in the water supply. Alum dosage seemed to offer the best possibilities, but it is doubtful, however, whether the comparatively large amount of alum necessary to effect their removal is a justified expenditure. If it were true that these forms were known pathogens, their removal would become necessary, but if they are merely to give us data as to the removal of sewerage matters, we have a better indicator in the bacterium coli.

Minnesota Roads Turnpiked for $150 Per Mile

In a testimonial to a gasolene or kerosene tractor manufacturer, D. R. Savage, district engineer, Windom, Minn., writes in part:

When we first began to build roads in Cottonwood County with a tractor and blade grader we thought that one day would make a mile of road, but our standards have changed and now we put four days and sometimes more on a mile.

We begin by staking out a road with two rows of stakes, 40 feet apart, generally putting a pair of stakes at every second telephone pole. We cut down 18 inches deep into the middle. This will make a crown of about a foot of dirt in the middle of the road which will make a raise of 30 inches from the bottom of the ditch to the top of the crown. Two rounds carries the dirt from the ditch to the center generally, as we use two 12-foot blades. We con-

sider that the packing effect of the engine is fully as valuable as the moving of the dirt.

We generally, in making the first cut of sod, make a wide shallow furrow in preference to the narrow and deep furrow, as this splits up the sod more and then after it has been rolled over and pressed down with the engine, we give it another scrape in moving it over to the center and all this tends to obliterate the sod. Sod is no problem, as we can use it and crush and cut it up. It only means a little more work.

A great deal of our work might be termed "finishing," as all the time we are smoothing out and working the dirt back and forth.The last touch is to run the blades out and cut off the top of the crown and push it out to the shoulder, leaving a twenty-four foot roadway with about a foot crown to it.

When we first began to build roads, we were satisfied with a smaller ditch and poorer finish, but experience has shown us that the road might as well be built right in the first place and be done with it, as otherwise it will have to be reshaped in a few years.

We finish about twenty miles in a year, and besides do a lot of temporary work and reshaping of roads that demand immediate attention.

Last year we put six weeks into maintenance work, which meant making one to three rounds over all in the county designed as state road, which we had to care for and which was not yet constructed.

In these roads the top of the road had become concave, instead of convex, and there was nothing for the road drags to work on, so we knocked off the shoulders and then drew some fresh dirt up into the middle of the road, so that the road drags would have something to work on.

The cost of the turnpiking and finishing a road is generally about 3 cents per foot, or $150 per mile.

Road Convention Papers

Excerpts from papers read at the Chicago Convention of the American Road Builders' Association at Chicago, January 17 to 20. Owing to space restrictions none of the papers can be given in full, but only those parts are selected that seem in our judgment to convey the ideas of greatest importance or interest.

The Highway Outlook

By Thos. H. MacDonald,
Chief, U. S. Bureau of Public Roads

There is the universal demand for economy which must be met. There is the insistent demand for the lowering of taxes which must be heeded. These same facts apply to local, State and Federal expenditures and taxes. On the other hand, there is

The unemployment situation,

The competitive period ahead,

The demand and necessity for internal improvements.

The situation demands wisdom, foresight, leadership of the highest character. Wise expenditure is more necessary than uneconomical saving. Thus the highway outlook is not determined by any narrow or limited consideration but by all the broad social and economic relationships with which the highways have intimate contact.

We need to establish a highway balance sheet, national in extent, on which we set up,

On one side, 1, the funds available; 2, the economic situation; 3, prices and costs for highway improvements.

On the other side, 1, the deferred highways improvements; 2, the returns from highway investments; 3, the need of universal easy and cheap transportation facilities.

Funds Available

Year	Total expenditures, approx.
1904	59,527,000
1914	240,263,000
1917	279,915,000
1918	286,101,000
1919	389,455,000
1920	500,000,000
1921	600,000,000
1922	720,000,000*

Sources of revenues. On the basis of the estimated total highway expenditures for the year 1921, the sources of this fund are approximately as follows:

Motor vehicle revenues	19%
State road bonds	7
Local road bonds	33
State taxes and appropriations	12
Federal aid	14
County, township, dist. taxes and Ass.	14
	100

It would be unfair to say that the unprecedented depression in which we find agriculture today is due wholly to the very large increases in freight rates which have been imposed during the past years, but it is fair to say that these increased freight charges are a large factor in retarding agricultural recovery.

* * *

The purchasing power of the major farm crops, is probably lower than at any time in our history and this has very much to do with the nation-wide industrial and business depression. The conclusions are self-evident.

1. During the period 1910-1921, the potential number of motor vehicles demanding highway service increased more than 1800 per cent. Our actual expenditures for construction and maintenance increased about 400 per cent.

*Is the estimated sum which has been made available but subject to conditions and limitations that will materially reduce the total which is actually expended.

2. During the period 1910-1914, motor vehicles increased more than 100 per cent, highway expenditures about 140 per cent.

3. During the period 1914-1921, motor vehicles increased about 700 per cent. and highway expenditures about 200 per cent. of the 1910 figures.

But even these figures do not truly represent the differential between the demands for highway service and our actual production.

Cost Keeping on Highway Construction

By A. R. Losh,
Assistant Chief of Construction, U. S. Bureau of Public Roads

Of recent years, due to a scarcity of contractors in the highway field, it has been necessary for States and counties to do a large amount of highway work with day labor forces and the value of cost keeping as a check on expenditures and as a guide to efficient management has led to the installation of cost keeping of some kind on this work. In addition to serving these ends many valuable cost data have been accumulated which form an important part of the fiscal records of the work and have also been used advantageously in placing other work under contract. With one State highway department cost keeping on contract work is incidental to the inspection and the resident engineer or inspector is to considerable extent left to his own devices in this regard, while with another State highway department the cost keeping is one of the important functions of the residency and not considered a sideline by any means.

When the cost on contract work is considered advantageously the method followed is either to select the jobs which will supply the information desired or to cover the entire program and keep costs on all contracts. In either case there should be sufficient force available to handle the inspection and cost keeping properly. It will be difficult if not impossible to secure satisfactory results unless the inspectors or cost keepers receive specific instruction as to what they are to do, are supplied with standard recording and report forms, and their cost keeping supervised as well as their inspection work. * * *

The advantages resulting from keeping costs on contract work are usually given as follows:

1. Valuable cost data are secured which may be used for estimating purposes.
2. The department has available necessary cost data for making settlement with contractor where unforseen conditions are involved.
3. Engineers and inspectors receive training in use of cost data and making up of estimates.
4. Provides a means for analyzing cost of work which may lead to development of more economical designs and methods.
5. In some cases of assistance to the contractor who may not have an adequate cost system.

The Bureau of Public Roads has abandoned the practice of keeping costs on all of its contract jobs but is instead keeping costs on all day work and on such contracts, where it is though the data will be advantageous to the Bureau. It will prove advantageous to a State highway department to collect cost data on a number of representative contracts each year as a general check on the cost of its designs and also to determine the margin of profit contractors are getting.

The increasing use of cost keeping by contractors is even more pronounced than in the case of the State and county organizations. * * * Highway contractors are now working individually and through their organizations for more systematic and business-like methods in estimating work and in the keeping of construction costs. * * * The present tendency is for highway contractors to develop cost keeping systems comparable with those in use by the building industry. * * *

For a contractor's use, the cost system should furnish reliable data on current costs. * * * Next in the importance to the contractor is the value of cost data as a guide for estimating future work. The increasing complexity of highway construction is making cost keeping of more importance. The large sums of money now involved in road contracts mean more items of work, new processes, and additional operations over former requirements. To estimate the cost involved without comparable cost data is becoming too costly a hazard. It is not enough to know that there was a net profit on the job, but in order to use the data for estimating purposes it must be known by items and operations the actual cost of production. * * * Cost data on new or unusual methods of construction and on the use of various plant units are of particular value as similar conditions are likely to be encountered in the future and a basis for cost estimates is available.

It is believed that the proper basis for a cost system is the four principal elements of cost allocated to the units of production.

(a) Labor costs.
(b) Material costs.
(c) Equipment costs.
(d) Administration costs or general expenses.

The products or highway construction to which these cost elements are assignable are road parts. Fundamentally these parts are:

(a) The right of way.
(b) The roadside, shoulders and grade.
(c) The traveled way or roadway proper.
(d) Drainage channels or ditches and drains.
(e) Drainage structures or bridges and culverts.
(f) Supplementary structures of miscellaneous road parts, such as guard rails, retaining walls, guide posts, etc.

Thus, there are six major products on each of which there may be four elements of expense or cost; consequently, we have 24 cost divisions. Since general expense is not ordinarily ascertained directly on production but is pro rated to the various operations the actual cost divisions with which the cost keeper is directly concerned are reduced to 18. It is believed that this is the minimum number of cost divisions which will provide a satisfactory highway cost keeping system.

These cost divisions are susceptible of much further analysis by breaking them up into various operations. For example, a square yard of concrete roadway is one of the unit products. The cost divisions for this are three, i. e., labor, materials, and equipment. To these three may be added the pro rated general expense. For further analysis, this square yard of roadway may be subdivided into subgrade finishing, placing of forms, hauling materials, mixing concrete, placing concrete, curing concrete, etc. * * *

In placing the cost items against the appropriate construction items the greatest difficulty appears to

be in correcting with equipment costs and "administration costs." It is the experience of the Bureau of Public Roads on its own work that these items are given less attention in the preparation of estimates and in the segregation of cost to construction items than the more nearly definite items of "labor" and "materials."

The handling of equipment costs has been greatly simplified by the use of a rental factor computed to cover fixed charges, depreciation, overhauling, lost time, storage, and supervision. In the case of its own plant the Bureau has prepared rental schedules for all units of equipment having a useful life of more than one working season and costing more than twenty-five dollars. Small tools and those which are usually worn out on one job are handled the same as materials. This plan has been in operation three years and except for a change from a monthly to a daily basis it is practically the same as originally developed. It has proven satisfactory on both day labor and contract work of the Bureau. A rental factor of this kind is necessary where current costs are determined for purposes of management. * * *

As general expense is not usually assignable directly to units of construction and many of the expenditures do not come to the attention of the cost keeper on the job there is a tendency to overlook this element until the project nears completion, at which time the cost is pro rated to the work completed. The result is a sudden jump in unit costs. Even with this apparent defect this may prove the best method to adopt as it greatly simplifies the handling of general expense items. Where limited funds require careful attention to gross expenditure on a project this method is not recommended. Occasionally it is found that the general expense is quite high in starting a job and if this is pro rated to the small accomplishment during the first few weeks of the work there are shown abnormally high unit costs which are not a true indication of conditions.

Two suggestions are offered for the handling of general expense. First, it will be found advantageous to divide general expense into two parts, one of which includes those costs which are assignable directly to the project and the other the general administration costs of the organization which must be pro rated to all its various projects. This latter part need not be considered in current cost reports as it does not in any way affect the efficiency of the construction organization on the project. This part of the general expense may be apportioned to the project upon its completion.

The second suggestion is that the amount of general expense (project) taken up and pro rated on current reports be a percentage of the total probable general expense, which percentage to be not greater than the percentage of the project completed. For example, if the project is only 10 per cent. complete, pro rate to completed work not more than 10 per cent. of the total probable general expense. On projects where the cost of "moving in," "camp installation," "organizing" and "disorganizing" is of a considerable amount the unit construction costs are liable to be materially affected if this entire cost is distributed before the work is well under way. * * *

Insofar as field procedure is concerned simplicity is a very important consideration and it should be such that the required data can be successfully compiled by foreman and timekeepers. The effectiveness of the system will depend to a great extent on the celerity with which the unit costs may be ascertained. Unless the cost of doing the work can be determined easily and promptly its value as an aid to efficient management is lost. Some consideration should be given to making the cost system adaptable to the general work of the organization and not design it entirely for an individual job or set of conditions. * * *

A great step forward would be accomplished by a general classification of cost keeping terms. Many of these as now used are subject to several interpretations. Engineers and accountants could materially improve the situation by reaching a common understanding in this regard. * * *

Highway Economics

By W. K. Hatt, Director, Advisory Board on Highway Research, National Research Council, Washington, D. C.

The proportion of the National wealth available for the purposes of transportation is limited. This proportion must be distributed among the various agencies, railroads, highways, etc. Inasmuch as the money spent on one agency is not available for another, it is clear that highway transport is intimately bound up with transportation in general. At present we see but dimly this new form of transportation, highway transport which has come upon us in the past fifteen years. No men can think wisely, and no legislation can be properly based, until the data of economics of highway transport are assembled and analyzed.

That part of the national wealth devoted to highways should represent capital invested, earning dividends, and not capital consumed. Therefore, the location and type of road, should be based upon the traffic, present and future, the climatic conditions, the foundation and available materials. In other words, the economic balance between capital cost and operating expense should be maintained. The highway should be designed, as an engineer designs anything else, to fit the conditions.

But when we speak of operating costs, where are the data? Who knows the maintenance costs of various types, properly allocated to surface, shoulders, ditches, etc., and the replacement cost; and the traffic that reflects itself in these costs? And who knows the operating costs of the vehicle arising from roads of various grades, lengths and surface? Since somewhere near 12 dollars are spent on the vehicle where one dollar is spent on the road, the survey of the situation should not be confined to the road.

And who should pay the cost of highways, the user alone, or property and user? What part of the cost should be met by bonds and what part by current funds?

Now it is clear that highway development in the future must depend upon a more critical economic analysis than in the past; and the highway transport officials must prepare their case. The data of economics of transport must be gathered as rapidly as possible.

On the enginering side we have made rapid progress, studying materials, strength of road slabs to

carry loads over various conditions of sub-grade. So that when the legislators tell the engineer what maximum load he is to provide for, a fairly consistent design will be forthcoming. But will the legislator decide this question, arbitrarily?

The Advisory Board on Highway Research, of the National Research Council, has its sleeves rolled up, and is on the job. Its job is to draw up a comprehensive program of highway research, to make use of the research agencies in this field of research, and to collect and distribute the information that will allow a wise judgment upon these questions.

Bituminous Foundations for Street and Road Pavements

By Hugh W. Skidmore,
Of the Chicago Paving Laboratory, Inc.

The two most important elements affecting the design of pavements for both city streets and county roads are the character and the intensity of the traffic to be carried. These two factors combine to determine the probable destructiveness of the most potent of all traffic forces—impact. There are other important considerations, such as bearing power of soil, temperature variations, drainage, quality and quantity of local materials, etc., but all of these are of secondary consideration when compared with traffic. The remarkable changes in kind, weight and speed of vehicles which have occurred in the last few years, have necessitated departures not only from some of the accepted practice formulae pertaining to various pavement types; but also from some of the previously conceded standard types of foundation and wearing surface construction.

It is ridiculous to assume that any one type of foundation or wearing surface will prove the best under all conditions. In fact, it is often times the case that more than one basic design should be used within a given length of pavement. * * *

Two schools of thought, as applied to pavement foundations, have been evolved. These are essentially different in their fundamental principles. One of them seeks to overcome the destructive effect of the traffic loading, which at any instant may be converted into impact of variable intensity and often equivalent to several times the dead load, by means of a rigid slab possessing strength superior to the possible force of impact; the other dissipating the blow by absorbing a very considerable portion thereof through a flexible structure, which is always in actual contact with the sub-grade, thereby insuring greater uniformity of load distribution and functioning as a distributing medium or foundation and not as a deflector.

RIGID TYPES

Rigid types, since they must possess strength superior to the traffic forces, have undergone in rapid succession modifications, which, with few exceptions, have been of such nature as to increase the original cost of the pavement very substantially. Perhaps the most important reason underlying the necessity of these modifications is the fact that the rigid slab is not at all times in actual contact with the sub-grade, and, therefore, does not always function as a distributing medium, but must sustain the entire force of the loading within itself. The fact that concrete pavements warp due to temperature stresses indicates that at almost any time the rigid slab can be expected to be functioning either as an arch, with bearing at the outside edges of the slab and free from the sub-grade in the central portion—or functioning as a simple cantilever beam, with the fulcrum at or near the crown, and with the outside edges not in contact with the sub-grade; therefore, the maximum strength of the rigid pavement slab will be demanded when it is acting as a cantilever beam. The internal stresses in pavements, created by changes in temperature, often times become very powerful forces and to date the rigid type of construction has failed to offer uniformly satisfactory resistance, as evidenced by cracking.

While it is true that the seriousness of such failures is often reduced by more careful attention to drainage, preparation of sub-grade, etc., they are, nevertheless, admittedly inherent weaknesses in this particular type. Soil conditions in certain sections of the country may be such that during a portion of the year the bearing power of the soil will be so low that it cannot be relied upon as offering any very substantial support to the pavement structure. The unstable soil condition may be of limited extent and the soil may be of such character as to admit of ready drainage so that proper attention to this feature will remove the difficulty. Again, unstable soil during a considerable portion of the year may prevail more or less generally throughout certain localities, or the soil may be of such nature that it is practically impossible to adequately drain it even with very elaborate structures. In such cases the construction of sub-foundations may prove a practical solution, while at other times it will be found that a rigid pavement structure will be the most economical. Likewise often times a combination of sub-grade drainage and the construction of artificial sub-grade or sub-foundation overlaid by either a rigid or a flexible type of structure will prove to be the most adequate solution. * * *

FLEXIBLE TYPES

Flexible and semi-flexible pavement structures are the oldest types known, and we have only to picture the old Roman roads to realize that the soundness of such construction was thoroughly demonstrated long ago. * * *

Flexible foundations include gravel, broken stone, waterbound macadam, bituminous macadam, and hot-mix bituminous concrete. They are usually classified as to value in a pavement structure in reverse of the order named with bituminous concrete as the highest type. It is estimated that there are 15,000,000 square yards of "black base" giving satisfactory service in this country.

The bituminous foundation structure, although possessing considerable beam strength, functions primarily as a shock reducer, that is, it *gives* slightly under the blow of impact in transmitting the load to the subgrade. Therefore, the design of this type places considerable reliance in the load supporting power of the subgrade. Its use then is dependent upon a knowledge of the ability of the subgrade to supports loads equal to the probable force of impact reduced by the slab strength residing in the bitum-

inous structure; whereas the rigid type, regardless of the bearing power of the soil, must be built to sustain the entire force of impact. For this reason a much thicker rigid foundation is required under given traffic and subgrade conditions, as has been demonstrated by impact tests.

It will be readily seen that even where soils are of questionable value as a subgrade, bituminous foundations may still be employed economically, if an artificial subgrade of broken stone, gravel, boulders, or even cheaper materials, is first constructed. When old macadam or gravel roads already exist, an excellent artificial subgrade is offered at almost negligible cost. If widening is necessary this can usually be accomplished as in the case of the Kingston Pike at Knoxville, Tenn., where "black base" was laid about four inches thick over the old macadam and 7 inches thick at the edges of the widened pavement.

In the West, where the most extensive yardage of bituminous foundation has been laid, the general practice seems to be in taking alternate bids to specify 5 inches total depth for "black base" pavement and 7 inches for Portland cement concrete pavement of 1-2-3 mix. And the general opinion appears to be that the "black base" type is giving superior service. Almost universally bids for "black base" pavements have been less than for either Portland cement concrete pavement or asphalt wearing surface on Portland cement concrete base. The saving has varied from 20 to 60 cents per square yard.

CONTRACTORS' VIEWS

Questionnaires were sent to well-known concerns throughout the country. Both the number of replies, covering every state and parts of Canada, and valuable data contained in them, greatly exceeded expectations. * * *

The experience of contractors is such that they are willing to guarantee "black base" as readily as Portland cement concrete, and with few exceptions, stated that less risk was attached to "black base." The experience of contractors generally has been decidedly lower maintenance expense, and lower first cost except in a very few instances where freight rates proved to be an extraordinary item. Assuming equal depth of foundation, the use of same aggregate materials in both types, and Portland cement concrete not to exceed 1 3-5 in richness of mixture, 90 per cent estimated a difference in initial cost of from nothing to 50 cents per square yard less for "black base" and 75 per cent estimated "black base" at from 25 to 50 cents per square yard less than Portland cement concrete. Since it is true that under similar traffic and subgrade conditions, less depth of "black base" is required, it will be readily seen that rigid foundations will usually cost substantially more than the highest type of flexible base.

One contractor said that during the past 14 years, 85 per cent of the pavements he has laid have been upon flexible foundations, including broken stone, macadam and a goodly yardage of "black base." * * * The only objection raised to "black base" construction by any of the contractors was the possibility of idle equipment in the event a protracted rainy season was encountered on work where the subgrade did not drain readily.

A Southern contractor's reply seems to typify the attitude indicated by all of them—"Our opinion is that engineers will be performing a useful service in securing the adoption of specifications for black base as an alternate to the use of concrete base."

ADVANTAGES OF BITUMINOUS CONCRETE FOUNDATION

1. Because of greater resistance to impact, permits the use of a thinner base course than is required of the rigid types.
2. Provides uniform contact with the subgrade, thus insuring greater uniformity of local distribution, and precluding the necessity of relying upon the pavement structure to sustain the entire force of the traffic loading.
3. Provides homogeneity of mass and positive bond between wearing course and foundation when bituminous top course is employed.
4. Provides freedom from cracks, upheavals, and ruptures which are common to rigid types.
5. Insures against the presence of moisture in the foundation structure, thus prolonging the life of the pavement.
6. Does away with the long period of time required for the curing of Portland cement concrete, thus permitting the opening of completed work to traffic immediately and providing a greater rapidity of turnover to the contractor.
7. Permits the use of the same aggregate materials as are ordinarily employed in Portland cement concrete, foundations, and provides decided construction economies.
8. Under given conditions costs substantially less than rigid construction.
9. Maintenance expense is less than for rigid pavements.
10. May be easily repaired at minimum cost, the surface patch method being applicable except in the case of serious defects.

Politics Eliminated from Ontario Highways

Addressing the past presidents and directors of the American Road Builders' Association, the Hon. F. C. Briggs, Minister of Public Works for the Province of Ontario, Canada, declared that road building in his territory is divorced entirely from politics.

"We have 57,000 miles of road all told in Ontario," said Minister Briggs. "We propose to spend $25,000,000 on new roads this year. We have 2,000 miles of improved roads now under maintenance. The Dominion Government pays 40% of the maintenance; the Province of Ontario 40% and the municipalities 20%. In municipalities of less than 750 population, our roads are built through the municipality without cost to the town. If the town is above 750 in population the Province pays 40% of the central 20-foot width.

"Politics is not known in road construction in Ontario. We have no commission to blame for anything. The Minister of Public Works is responsible to the people from the floor of parliament. Our people are not favorable to commissions. If the Minister of Public Works does not make good, he finds after the next election that somebody else has his job.

"All of the bridge construction in Ontario of whatever nature, whether the bridge be 10 feet long or 1,000 feet long, is done by my department. We have a staff of 65 engineers, all of whom are directly responsible to the head of the department. Of this staff 97% served with the Canadian forces in Flanders or France. We are rather proud of our part in that."

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Imhoff Tanks and the New Jersey Health Department

We have received the following letter from the author of the articles on the Imhoff tank which began in the January 21st issue and will be concluded next week.

January 27, 1922.

Editor of Public Works,
New York City.

Dear Sir:

I note in the publication of my article on "Sewage Treatment in Imhoff Tanks" in the January 21st number of PUBLIC WORKS that in one or two places you refer to the conclusions therein as being those of the State Department of Health of New Jersey. This is especially apparent in the subtitle and in the editorial.

While much of the material was secured from personal observation and inspection in the course of my duties as assistant sanitary engineer for the Department, the views and opinions expressed are strictly my own and in no sense those of the Department.

It is therefore requested that you correct at the earliest possible date the impression given by the sub-title and editorial as published.

Very truly yours,
Russell Riker.

We hasten to give this letter as early and prominent publicity as possible, and to express our regret that we should have given any occasion for it. We must plead guilty to giving in the sub-title the impression referred to by Mr. Riker, but in the editorial we were particular to state that the opinions given in the article were "the views of the writer" and "the ideas of Mr. Riker personally," and "not officially given out as" those of the department, although we supposed that they might be considered as such.

We hope that this explanation will reach the eyes of all who may have seen the article, and correct any impression they may have received as to the department sharing Mr. Riker's views on the subject.

Equating a Great Engineering Project

With lavish use of time, labor, capital, materials, and equipment, almost any engineering or construction problem plausible enough to receive serious attention may be executed so as to function fairly well. It by no means follows that such an accomplishment is necessarily entitled to be considered a success. If success is to be properly assured, the work must measure up to various standards of safety, durability, economy, efficiency, value, and in many cases to commercial justification.

With unlimited expenditure of time, money and often of human life it is now possible by the aid of artificial power, mechanical equipment and scientific developments to accomplish construction operations involving enormous dangers and difficulties. But unless such are vital to the public safety they should not ordinarily be undertaken until it is clearly demonstrated that the reasonably certain results will fully justify the various items of direct and indirect cost and show an unquestioned balance in favor of public welfare, development or commercial profit.

Since the beginning of the last war the orgy of expenditures in life and public resources have been so great that the sense of proportion and value of the ordinary citizen is largely dulled, and because they may be scientifically or mechanically within the range of possibility, stupendous engineering schemes are seriously discussed when there is little chance that they would be justified by any reasonable consideration of probable results.

Within the limits of private or corporate investments, the test of profit or earnings goes far to restrain these projects, although it does not always prevent their manipulation by unscrupulous or incompetent men anxious to handle large sums of money for what can be made in the process, without regard to ultimate conditions and results. For very large enterprises that require government finances the danger is much greater on account of the ease with which government funds are recklessly diverted by astute politicians or financiers with little regard to sound business principles.

It may be quite possible to double the maximum existing bridge span at five or ten times the expense of the most costly similar structure in the world: to dam the Niagara river for the development of a not yet necessary huge water power; to turn the finest roadstead and most beautiful harbor in

the world into an artificial peninsula; or to build rival tunnels where all resources should be concentrated upon one. All these things may indeed be accomplished by the expenditure of hundreds of thousands or millions of dollars commandeered from staggering taxpayers, but such enterprises should not be lightly undertaken or undertaken at all until their cost can be kept well within their conservatively capitalized values.

Considerable effort has been made to force the United States into the joint construction of the St. Lawrence ship canal through foreign territory. The idea of making an ocean route to the northern and central states and Mississippi basin is appealing, but it should not be exploited until, following deliberate investigations, the highest commercial, financial and engineering authorities have approved of it. The statement of the chief engineer of New York State and others, which is summarized on another page of this issue, indicates that the cost would be tremendously greater than the estimate submitted by the promoters; that the capacity would be much impaired and the cost of transportation increased by the different ocean and lake conditions encountered; that the canal could be only intermittently used; that it is not the only nor the most suitable ocean pathway to our inland states; and that its operation would actually injure the splendid equivalent waterway within our own boundaries on which $200,000,000 has been expended and which is not yet utilized to anywhere near its potential capacity. These facts should give pause to even the most ardent proponents for American construction for an alien ship canal.

Locomotive Turntable for Graveling Highways

The construction of 8½ miles of gravel road No. 5 in Cherokee County, Iowa, was facilitated by the use of a special dumping appliance devised, constructed and operated by Roorda Bros., contractors.

The device consists of a power operated locomotive turntable built partly with a Ford engine radiator and truck wheels, that travels along the highway and provides for the quick and accurate dumping of loads of gravel irrespective of soft or rough surface, secures even distribution of the gravel, facilitates its spreading and the turning and dumping of the trucks.

The power driven turntable is installed two or three feet above the surface of the road on a long I-beam platform, at the front end of which two riveted stringers or plate girders are attached to the floor at one end and rest on the ground at the other end, forming skids up which the Ford trucks loaded with gravel ascend to the platform and mount the turntable. The latter, revolved by power, turns the truck completely around, after which it is dumped and descends into the roadway again, completing the whole operation rapidly and with much more accuracy and convenience than by the ordinary methods.

A sliding rod on the platform scratch-marks the center of the dumped load, and after it has been dumped the platform advances until an index on it coincides with the scratch mark and it is stopped to receive the next load and so on. The truck is loaded with an equal amount of gravel for each trip to insure a perfectly uniform distribution by means of this inexpensive home-made device, which is operated by one man.

The gravel trucks have Ford chassis with a special body, designed by the contractor. They are heavily loaded and are expeditiously hauled out of the gravel pits by a Fordson tractor with a long cable.

Objections to St. Lawrence Ship Canal

The proposal to canalize the St. Lawrence river and build new structures in Canadian territory to provide another shipway from the Atlantic Ocean to the Great Lakes by the joint effort of the Dominion of Canada and the United States is discredited by the investigation of Frank M. Williams, state engineer of New York, and others. It calls attention to highly unfavorable physical conditions, the very dangerous and often fatal fog zone at the eastern terminus that causes the refusal of all naval insurance there after November, and the severity of the winters that closes the route for about one half of every year. The transformation of the highly economical and efficient lake carriers to make them suitable for canal and ocean service would retard their speed and very greatly increase their operating cost. According to their revised estimate, the International Joint Commission's estimate of $252,000,000 for the cost of the project is far too low. With the completion of the work by the development of the full 4,000,000 h.p. claimed, the cost will be $1,300,000,000 plus an unknown, but heavy, property damage.

The United States will gain nothing in power rights, which it already possesses in the river much beyond the 1,000,000 h.p. which might be allotted to it, because the power rights already belonging to the State of New York would be turned over to the joint American-Canadian Commission and the State of New York would in addition to this great loss of potential energy compelled to pay 28 per cent of the Federal outlay on the canal.

Furthermore, Mr. Williams claims that the canal is neither necessary nor best, but that the Erie canal, the Barge canal and the Hudson river already furnish a magnificent connection between the Great Lakes and the Atlantic, serving exactly the same territory that the International canal would serve and representing around $200,000,000 of work that has already been expended on them and a construction that is not utilized to anything like its present capacity and is capable of great enlargement at a price far within the construction of the St. Lawrence canal and which would tend wholly to the prosperity of this country rather than to aid in the competition of a foreign country. The claim that the St. Lawrence ship canal would save 10 cents per bushel on grain freights to Liverpool seems to be refuted by the statement, made from detail records, that the normal total cost of shipment from Duluth to Liverpool via Erie canal is only 10.73 cents per bushel.

Sewage Treatment in Imhoff Tanks*

By Russell Riker

Experience of a number of plants with foaming in the gas vents. Operating data of New Jersey tanks.

Most of the operating trouble with Imhoff tanks in this state is due to scum formation in the gas vents. At Washington, Princeton, Westfield and Plainfield the scum collects to such a depth as to cause solids to rise up through the slots. The operators could not keep down the heavy scum and were able to deliver a satisfactory effluent only by daily removal of the floating material on the surface of the settling chamber. Within the past year foam has overflowed the gas vents at Plainfield, Pitman and Oaklyn. The accompanying photographs illustrate the condition at Plainfield and Oaklyn.†

Many of the operators endeavored to remove the scum from the gas vents but at many of the plants this procedure is very difficult. At Plainfield two men were kept busy removing scum. At Pitman the operator reported that over 100 wheelbarrow loads of floating sludge and scum were taken from the gas vents in an interval of one month. At present more attention is given to removing the scum from the surface of the settling chamber, and the scum in the gas vent only agitated enough to allow the gas which is continually arising from the decomposing sludge to escape.

At some plants it has been impossible to draw sludge due to the fact that all the sludge was floating in the gas vents. At Washington the sizes of the units used in the design are well above the average, yet after the tank had been in operation for some time sludge belched up through the slot and it was thought that the sludge digestion chamber was filled to a level above the slot. An attempt was made to draw sludge through the regular sludge channels but only a black liquid discharged on the sludge bed. Upon examining the gas vents it was found that they were completey filled with a thin, viscous sludge with a heavy scum coating. Sewage was bailed from the settling compartment and discharged into the gas vents, which loosened the scum so that it could be agitated. In a few hours a little sludge could be drawn, but the next day the settled sludge again came to the top. After standing all winter it was found that all the scum had settled to the bottom.

The Imhoff tank treating the sewage of Princeton University caused considerable trouble for a number of years and it is only recently that it may be classed as a fairly satisfactory operating plant. During the last few years the tanks have not foamed over the gas vents, but there has been considerable belching in the settling compartment. Soundings indicated that the gas vents are filled with fine viscous sludge which is kept loose enough by continuous agitation to allow the gas to rise and escape. Below is an analysis of sludge taken in 1917 as compared with analysis made in 1921.

	Wet Sludge			Dry Material		
Date	Reaction	% Water Content	% Dry material	% Fats	% Non Vol.	% Vol.	% Fats
1917	Highly Alkaline	93.92	6.08	0.416	37.89	62.11	6.91
1921	Highly Alkaline	94.04	5.96	0.051	48.53	51.47	0.85

Odor: 1917 Musty; 1921 None

The most outstanding feature concerning this analysis is the reduction of the grease from 6.91 to less than 1 per cent. of the dry material. Grease traps have been perfected to collect grease from the mess halls of the University and this may be responsible for the improved operation of the plant.

The operation of the two-story tank at Plainfield is familiar to most engineers. Foaming has been common since the plant was installed in 1916. Every known method has been used by the operator, who is a technical man, to overcome this bad feature, but without any marked improvement. The operator claims that better results have been obtained since fine screens were installed to treat the raw sewage and the tanks alternated every fifteen days. Although foam does not overflow the gas vents as often as in the early days of operation, there still accumulates a mass of floating sludge of so slight a specific gravity that it will not settle. As this material increases in volume (there is no way of withdrawing it from the gas vents) it is carried up through the slots into the settling chamber, causing a very poor effluent.

The Oaklyn tank was placed in operation December, 1915. The tank worked very well up to 1921. There was no initial foaming period and the plant received very little care or supervision. Sludge drawn about every three months was good and the effluent was also satisfactory. The tank has a round sludge digestion chamber of 2,000 cu. ft. capacity and a longitudinal horizontal flow settling chamber. The gas vents are in the form of a segment.

In 1920 a new full-time operator began to remove sludge more frequently from the tank. From October, 1920 to May, 1921, he removed 1,250 cu. ft. of digested sludge, considerable more than the quantity of fresh sludge deposited during this period. A few days after the last sludge removal the tank began to foam violently. Some idea of the conditions as found by engineers from the State Department of Health can be obtained from the accompanying picture.

An investigation indicated that practically all the sludge had been withdrawn from the tank and that

FOAM OVERFLOWING GAS VENTS AT PLAINFIELD

*Continued from page 62.

†Foaming in the Oaklyn tank was shown on the cover of the issue of Jan. 21.

the digestion chamber and gas vent were filled with foam and floating sludge. After standing twenty-four hours a small quantity of this foam was reduced to 10 per cent. of the original volume, indicating that sludge transformed into foam will expand at least ten times its original volume.

A number of treatments were tried under the direction of the engineers from the State Department of Health. Milk of lime, kerosene oil and water were applied at different times to the foam in the gas vents but without any appreciable results. A very fine water spray installed above the gas vents was very successful in breaking up the fine bubbles and prevented the foam from overflowing the walls of the vent but did not keep the foam from rising. As these conditions existed for some time it appeared that the incoming sewage did not contain those qualities which were necessary to build up a satisfactory sludge. In order to do this artifical means were finally employed. An endeavor was made to kill off the undesirable bacteria in the tank and substitute bacteria of better digestive qualities.

About ten pounds of hypochlorite (30 p. p. m.) were applied to the sludge and five pounds were added to the foam in the gas vents. Twenty-four hours later 15 cubic feet (.2 per cent. of the capacity of the sludge chamber) of good ripe sludge were obtained from the separate sludge digestion plant at Collingswood and discharged into the gas vents of the Oaklyn tank. It quickly sank, when paddled, to the bottom of the sludge digestion chamber. For two days the vents continued to foam but on the third day the foam began to subside, and on the fifth day foaming had entirely ceased. No foaming has occurred since this treatment.

An interesting example of what may happen if a satisfactory grit chamber is not installed for two-story tanks is seen at Fairview, where each year the operator has to partly pump down the water in the Imhoff tanks and clean out the sand and grit. In the last six months over 20 cubic yards of grit were removed from one tank and 30 cubic yards from another. This condition has interfered with the operation of the plant.

It is extremely difficult to make a comparison between the operation of two installations, even when the unit sizes are the same. This is due to variations in the character of the raw sewage controlled somewhat by the character of the water supply. In the the southern parts of New Jersey the water supplies are usually obtained from deep wells which contain considerable iron, and along the Atlantic coast there is high chlorine content in the water. Those municipalities using surface supply in the southern part of the state contribute through their water supply a highly colored water of low alkalinity or sometimes acid. Some of the well waters contain much carbon dioxide, others hydrogen sulphide. Not only does the quality of the well water affect the raw sewage but the percentage of solids is also an important factor. In some municipalities the water consumption is double and even triple that of others. Again, some municipalities have a much higher infiltration into the collecting system of sewers. It has been found that a dilute sewage is handled much better than a concentrated sewage, especially when starting the tank. It has often been tried and is considered advisable to dilute the sewage when first placing the tank in operation. This has been done by pumping brook water into the sewerage system during the first few months of operation.

An examination of the summary, "Operating Data of Imhoff Tanks in New Jersey," would indicate that a stale sewage is treated much better in an Imhoff tank than fresh sewage. As stated before,

OPERATING DATA OF IMHOFF TANKS IN NEW JERSEY.

	Actual Flow Gals. Per 24 Hrs.	Kind of Collection System	Character of Raw Sewage	Reaction to Litmus	Sludge Distance Below Slot in Feet	Depth of Scum in Gas Vents in Ft.	Depth of Scum in Setting Comp.	Setting Efficiency Imhoff Glasses	Frequency of Drawing Sludge	Labor Aver. Man-Hrs. Per Day
Bayhead	250,000	Pumps	Stale	Alkaline	3	4	T	90	6 mos.	2
Chatham-Madison	300,000	½ Pump	Fresh/Stale	"	2	4	T	95	3 "	2
Fairview	400,000	Gravity	Fresh	..	4	1	A	60	1 "	3
Glen Gardner (State Inst.)	75,000	"	"	..	1	1	T	..	6 "	.15
Hammonton	300,000	Pumps	Fresh/Stale	Alkaline	4	3	A	95	1 "	2
Kenilworth	100,000	Gravity	Fresh	..	..	..	..	..	..	1
Factory (Domestic)										
Lodi	500,000	"	"	..	N	O	A	98	..	2
Maywood	300,000	"	"	..	F	F	T	75	..	..
Moorestown	500,000	..	..	..	..	..	..	..	..	..
Oaklyn	100,000	Gravity	Fresh	Alkaline	N	2	T	90	6 mos.	1
Pitman										
No. 1	300,000	"	Fresh/Stale	"	F	F	1	75	1 yr.	2
No. 2	100,000	"	Fresh	..	F	F	1	85	..	1
Plainfield	3,400,000	½ Pump	Fresh/Stale	Alkaline	2	3	T	98	1 mo.	27
Princeton Univ.	300,000	Gravity	Fresh	"	2	3	T	80	1 yr.	.3
River Edge	60,000	"	"	..	F	5	.25	25	1 "	.3
Sea Side Park	30,000	"	Stale	..	3	4	T	80	1 "	.15
Skillman (State Inst.)	300,000	"	Fresh	..	F	12	T	25	1 "	5
Ventnor	700,000	Pumps	Stale	Alkaline	3	0	0	90	1 mo.	2
Washington	300,000	Gravity	..	"	A	5	0	95	6 "	2
Westfield	600,000	"	..	"	F	3	0	85	6 "	1

N=Normal. F=Completely sludged up. T=Trace. A=Absent.

the depth of the digestion chamber has very little effect upon the quality of the sludge, although the summary may indicate that the deeper the tank the better the sludge, but the increase in quality does not justify the increase in the cost of constructing deeper tanks. It is regretted that more definite instructions cannot be given as how to establish satisfactory bacterial action and prohibit foaming, but no single method or combination of methods has yet been found to work under different conditions. As stated before, the application of hypochlorite of lime followed by a ripe sludge inoculation was successful at Oaklyn, but will it be successful at all plants?

(To be concluded)

Portland Cement Boycott Threatens Competing Mills

At the meeting of the Mississippi Valley Association of State Highway Officials in Chicago, Jan. 21, a resolution was signed by the chief executive highway officers of Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, South Dakota and Wisconsin, and was indorsed by representatives from Indiana and Ohio. It says, in part:

"Whereas it is practically inevitable that many millions of barrels of cement must be used annually in our programs, and,

"Whereas, manufacturers of cement have so far, in submitting prices for their product in 1922, entirely failed to measure the value of their industry to these large programs which have likewise entirely failed to measure the general decrease in commodity prices, in that no reduction was made in 1922 from the prices prevailing for the last four months of 1921, and the price named for 1922 is approximately only 10 per cent. lower than the price prevailing in January, 1921, which last price was likewise not in accord with the economic conditions prevailing,

"Resolved, by the executive officers of the highway departments of the states of Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, South Dakota and Wisconsin, assembled at Chicago at the fourteenth annual meeting of the Mississippi valley conference of state highway departments, that we pledge ourselves individually and collectively, as far as the power is reposed in us, not to make any contracts for highway construction involving the use of cement except the few contracts for work which cannot be possibly postponed until the manufacturers of cement have fixed the price of their product so that the road construction is not unduly penalized because of its magnitude, its urgency and its popular appeal, which price should be and must be in harmony with the reduced prices now in effect for all other basic commodities. Be it further

"Resolved, That we recommend that in those states in which laws and circumstances permit steps be taken immediately to investigate the possibility of erecting and operating cement mills to supply the construction needs of the state, since it appears that only in this manner can the cement industry be once more placed upon an open and competitive basis, and once more forced to follow general economic laws."

900 Railroads Sued for Lumber Rates Reductions

One of the most important and comprehensive freight rate suits brought by the lumber industry of the South, has just been filed with the Interstate Commerce Commission in Washington by the Southern Pine Association against all the railroads in the United States.

The Association asks for a general readjustment of freight rates on Southern pine lumber from the manufacturing territory to all destinations, and more than 900 railroads, comprising every line in the country, are named as defendants.

The petition alleges that the freight rates charged are excessive, unreasonable and unjust, discriminatory and prejudicial against Southern manufacturers and in favor of competing manufacturers. The Association also asks for simplification of freight schedules by the various railroads to be embraced in fewer tariffs.

Reductions in freight rates on Southern pine lumber equal to the reductions on hardwoods which were ordered by the Interstate Commerce Commission in its decision announced January 20, are expected to be made simultaneously with the hardwood decreases which are to be effective prior to March 6, next.

A. G. T. Moore, Traffic Manager of the Southern Pine Association, stated that at joint conferences held last December between Southern Pine Association representatives and officials of the Southwestern and Southeastern railroads, the carriers promised that the same reductions that were ordered by the Commission on hardwoods would be made voluntarily by the railroads on yellow pine shipments.

"The reductions just announced by the Interstate Commerce Commission on hardwoods," said Mr. Moore, "are not considered by us as sufficient to meet the commercial needs of the lumber industry in the South and are not enough to offset the greater reductions made in rates on lumber from the Pacific Coast to Chicago and points East.

Two-Track Roads on Curves

In constructing concrete roads around sharp curves in San Diego County, California, R. M. Morton, engineer for the highway commission, has used a special type of construction which serves the double purpose of preventing head-on collisions and also excessive fill or cut because of the superelevation of the outside of the curve.

The road is 18 feet wide on tangents, but is made 24 feet on sharp curves, and sufficient superelevation would bring the outer edge of the road considerably higher than the inner edge if the cross-slope were continuous. But the road is divided into two roadways, each with its own superelevation, the inner edge of the outer road being about a foot lower than the outer edge of the inner road. This tends to keep each car on its own side of the road. However, the two roadways are connected by a roll or ogee curve, the concrete being continuous from one roadway across the ogee curve to the other roadway, preventing an accident should a car skid from one road to the other.

Recent Legal Decisions

CITY TURNING WATER INTO CONSUMER'S MAIN CAN RECOVER FOR WATER ESCAPING THROUGH LEAK

A city, at a consumer's request, turned water into a main belonging to the consumer, to provide fire protection under a contract that the consumer was to pay a turning charge and a fixed amount for all water used. It appeared that the water leaked after it passed through the meter, apparently at a hole in the joint between two pipes caused by the packing being removed, though the cause was not discovered until after the city had made a claim for water furnished. The Alabama Court of Appeals holds, Anderson v. City of Montgomery, 89 So. 857, that the city could recover from the consumer for the water which had escaped through the leak in the main, the consumer being liable for all water that passed through the meter.

STATUTE RELIEVING HIGHWAY CONTRACTORS FROM CONTRACT OBLIGATIONS BECAUSE OF WAR CONDITIONS HELD VOID

The Indiana Supreme Court holds, Davis Const. Co. v. Board of Com'rs. of Boone County, 132 U. E. 629, that Indiana Acts 1919, c. 96, relieving highway contractors from their obligations under their contracts because of increased costs occasioned by the war, is unconstitutional.

ROAD SUPERINTENDENT ENTITLED TO SALARY EARNED

The Alabama Court of Appeals holds, State v. Stone, 89 So. 823, that where, under Laws Sp. Sess. 1920, p. 148, no county road engineer was elected who accepted the office until January, 1921, until which time the court of county commissioners continued the road superintendent as its agent, the latter was entitled to payment of his warrant for salary for December, 1920.

MEASURE OF DAMAGES FOR RELOCATION OF MAINS CAUSED BY STATE'S APPROPRIATION OF STREET

The State of New York, in constructing the Barge Canal, appropriated portions of a street in the City of Little Falls, necessitating the relocation of the city's water mains therein. The New York Appellate Division holds, City of Little Falls v. State, 190, N. Y. Supp. 807, that the proper measure of damages payable to the city is the fair and reasonable expense of the removal of the pipe line and its reconstruction elsewhere in the most economical way, and in the most available location. "The rights of the city to have its main in this particular street had no market value, except such as might rest in conjecture and speculation. In such unusual cases, it is necessary to abandon the stereotyped rules as to the measure of damages, which are not applicable, and take proof of damages in the best and most practicable and most reasonable way."

INTEREST COLLECTED ON DELINQUENT PAVING ASSESSMENTS BELONGS TO HOLDERS OF CERTIFICATES UNDER OKLAHOMA STATUTE

The Circuit Court of Appeals, Eighth Circuit, holds, Board of Comrs. of Pottawatomie County, Okla. v. Close Bros. & Co., 275 Fed. 608, that under Comp. Laws Okla. 1909, §727, providing that delinquent paving assessments shall bear interest at the rate of 18 per cent., as construed by the Supreme Court of the State, the county has no interest in such deliquent assessments and that the 18 per cent. interest collected thereon is for the benefit of the holder of the paving certificates.

"ABUTTING ON THE IMPROVEMENT"—ENTIRE WIDTH OF STREET NEED NOT BE PAVED

In proceedings to assess property for street improvements, the North Carolina Supreme Court holds, Anderson v. Town of Albernack, 109 S. E. 262, that the question of benefit is one of fact, and the governing board of a municipality under legislative authority is vested with the power to determine what lands will be benefited by the improvements, and their determination is conclusive upon the owner of the ground charged with the costs of the improvements, except in rare cases.

There are several methods of apportioning the costs of improvements, but there are two which are generally recognized—i. e., apportionment according to benefits and apportionment according to frontage—but the liability of the land to assessment is determined by the municipality under the authority of the legislature.

An objection that the owner's lot did not "abut on the improvement" because only 50 feet in the middle of the street was paved leaving a space of 22½ feet between the property and the paved portion of the street, was not sustained. It cannot be said that a street or sidewalk is not improved because it is not paved the entire width. By "abutting property" is meant that between which and the improvement there is no intervening land.

DRAINAGE DISTRICTS AS PUBLIC CORPORATIONS

Drainage districts are public corporations or corporate subdivisions of the state, authorized to exercise the powers granted to them for the purpose of their creation, within their territorial jurisdiction, as fully and with like authority as municipal corporations exercise their powers. State v. Albany Drainage Dist. Missouri Supreme Court, 234 S. W. 339. Arnold v. North County, Drainage Dist., (Mo. App.) 234 S. W. 349.

DRAINAGE CONTRACTORS HELD NOT ENTITLED TO DAMAGES FOR CARRYING OUT UNENFORCIBLE AGREEMENT

At the time of making a drainage contract, the contractors orally agreed to begin excavation at a point not required by the written contract. The Wisconsin Supreme Court holds, Schultz v. Three Lakes Drainage Dist. 185 N. W. 190, that though the contractors were not originally bound by this oral agreement, when they did comply with it by setting up their dredge and beginning excavating as agreed, they could not afterwards, in an action for damages because of directions given them in the progress of the work, say that the agreement was not binding upon them, or that they were damaged thereby, even though the commissioners may have insisted upon them doing as they did.

RIGHTS OF WATER COMPANY TO SELL AND MUNICIPALITY TO PURCHASE PART OF COMPANY'S PLANT

In a suit to restrain a water company from selling part of its equipment to a municipality, on the theory that the water company would not be able in the future to supply the plaintiffs, the New York Appellate Division holds, Town of Mamaroneck v. New York Interurban Water Co., 190 N. Y. Supp. 580, that there must be convincing proof, by a fair preponderance of evidence, that the proposed dismemberment of the plant will leave it destitute of the property, equipment and facilities, necessary for the performance of its duty to the plaintiffs, and that they will suffer irreparable damage thereby. It is also held that, under New York Stock Corporation Law, §16, as amended by laws 1920, c. 396, the water company has a right to sell its property, or any part of it, and that the city of Mt. Vernon has the right to purchase the company's property and engage in the business of purchasing water from the City of New York, and supplying and selling it without the consent of the Conservation Commission.

CROSS-TIES OF STREET RAILWAY PART OF TRACKS WITHIN PAVING ASSESSMENT STATUTE

The North Carolina Supreme Court holds, City of Durham v. Durham Public Service Co., 109 S. E. 40, that under a statute defining the space to be assessed against a street railroad company for paving the roadbed as "the space between the tracks, the rails of the tracks, and eighteen inches in width outside of the tracks of such company," the cross-ties are included within the term "tracks."

ASSESSMENT OF RAILROAD PROPERTY FOR STREET IMPROVEMENTS

The South Carolina Supreme Court holds, Atlanta & C. A. L. Ry. Co. v. City of Easely 109 S. E. 285, that railroad property abutting on a street is not exempt from street improvement assessments because the property is used for railroad purposes. "The public has a right to a street to get to the stations of the railroad, and it would be unjust and unfair to make other abutting owners of property pay and exempt the railroad * * * if these streets are good, facilities for transportation will be good, and the business of the railroad will be benefited."

CITY CANNOT DELEGATE TO LANDOWNERS POWER TO DECIDE ON BUILDING PERMIT FOR BUSINESS BUILDING IN RESIDENTIAL DISTRICT

The New Jersey Supreme Court holds, Levy v. Mravlag, 115 Atl. 350, that an ordinance which provides that no permit shall be granted for the erection of any structure to be used for the sale, at retail or wholesale, of goods, which is intended to be erected within 500 feet in any direction along any street where three-fourths of the property is used or intended to be used for residence purposes, until there be filed with the municipal authorities written consent to the intended use by, those representing the owners of three-fourths of the property used or intended for use for resident purposes within the limit specified, is invalid because the municipality cannot lawfully delegate the power of regulation to a special body of contiguous landowners within a limited district, for that power, if it exists in the municipal body, is legislative, and not administrative, and cannot be delegated. Such an ordinance cannot be justified upon the ground that it is necessary for public safety, and its only effect is to deprive the owner of his property or the use thereof without compensation, nor can it be justified upon the ground that it falls within the police power.

NOTICE OF DEFECT IN STREET AFTER REFILLING EXCAVATION

A city had made an excavation in a brick pavement to lay a water pipe connection and had refilled it temporarily so that the centre was 5 inches higher than the pavement. A few hours later the wheels of an automobile struck a depression in the filling about 12 inches deep in the centre, and ran into a trolley car. In an action for damages the New York Appellate Division holds Jones v. City of Binghamton, 198 App. Div. 183, 190 N. Y. Supp. 542, that the city was chargeable with knowledge of the condition in which it left the street surface. If the surface was left in a dangerous condition, the public should have been reasonably protected by lights or barriers or both. If it was left in reasonably safe condition for travel to be expected there and later, from some cause other than the unfinished condition in which it was left, a defect appeared, the city was entitled to notice of that defect before it could be held liable in negligence. If, on the other hand, the defect was due to ordinary travel, because of the unfinished and imperfect condition in which the city left the street surface—because its previous safe condition had not been restored—notice of the defect was not a condition precedent to a recovery by the plaintiff. Judgment of non-suit therefore reversed and a new trial granted. Two justices dissented, on the ground that the city could not be held liable, having had no actual or constructive notice of the defect, under Second Class Cities Law §244.

NINE MONTHS' DELAY IN ACTING ON ANNEXATION ORDINANCE HELD NOT UNREASONABLE

The Wisconsin Supreme Court holds, Roehrborn, v. City of Ladysmith, 185 N. W. 170, that, where a statute authorizing the annexation of territory by ordinance prescribes no time within which the ordinance must be acted upon, the council is required to act within a reasonable time. The court found no help from the authorities in deciding whether a delay of 9 months was unreasonable. A much shorter time is prescribed in many cases where local legislative and administrative bodies are required to act. It held that 9 months' delay though long was not so unreasonable as to make the action of the council void.

IMMATERIAL CHANGE IN PLANS OF ROAD IMPROVEMENT

The Arkansas Supreme Court Holds, Carson v. Road Improvement Dist. No. 2, 234 S. W., 257, that the commissioners of a road improvement district, duly authorized to construct an improvement, may make immaterial changes in their approved plans and specifications after the required submission of such changes to the county court, and that a change in the method of surfacing the road, adding only 4 per cent to the cost, is an immaterial change.

NEWS OF THE SOCIETIES

CALENDAR

Feb. 4-11—ST. PAUL BUILDING EXCHANGE EXPOSITION. St. Paul, Minn.

Feb. 7 — ASSOCIATED MANUFACTURERS OF WATER PURIFYING EQUIPMENT. Annual meeting. Bellevue-Stratford Hotel, Philadelphia, Pa. Secretary—H. G. Tate, 105 W. Monroe street., Chicago, Ill.

Feb. 8-9—NORTH DAKOTA SOCIETY OF ENGINEERS. Fourteenth annual meeting. Jamestown, N. D. Secretary—E. F. Chandler, University of North Dakota.

Feb. 8-10—MICHIGAN ENGINEERING SOCIETY. Annual meeting. Kalamazoo.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention, Cleveland. Secretary, Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' Bldg., New York City.

Feb. 20-23 — NATIONAL ASSOCIATION OF BUILDERS' EXCHANGES. Annual meeting. Hotel Chisca, Memphis, Tenn.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN ASSOCIATION OF ENGINEERS. Conference of practicing engineers. Congress Hotel, Chicago.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Audltorium, Cleveland, Ohio.

Feb. 24-25—ENGINEERING SOCIETY OF WISCONSIN. Annual meeting. Madison. Secretary — L. E. Smith, Madison.

Mar. 14-16—AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual convention. Chicago, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; April. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

PRACTICING ENGINEERS' MEETING

The American Association of Engineers will hold a conference of practicing engineers at the Congress Hotel in Chicago on Wednesday, February 22, Washington's Birthday.

The tentative program includes the following subjects:

How to sell engineering service.

Experience of the practical engineer with licensing.

(a) State reciprocity.

(b) Licensing of engineering corporations.

Publicity for practicing engineers.

Cost accounting for engineering service.

Bookkeeping for an engineering office.

How to uphold the standards of services and fees.

Amendment of schedules of services and fees.

(a) Providing for other branches, such as mining and mechanical.

(b) To fit to the practice appertaining to the several parts of the country.

Computing the practicing engineer's income tax.

The conference will be in charge of the Committee on Services and Fees of Practicing Engineers of the Association. An invitation to attend the conference is extended to all practicing engineers, whether members of the Association or not, who are interested in the subjects on the program.

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES

At its January 19th conference in Philadelphia, the Federation took up the question of "Recruiting and training apprentices, journeymen and workers in the building trades" as the most important problem before the construction industry today. The Board of Education, Builders Exchange, Union representatives and Industrial Relations Committee of the Chamber of Commerce discussed its various phases.

MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY

The twenty-seventh annual convention will be held February 21, 22 and 23 with headquarters at Curtis Hotel. Minneapolis, Minn.

February 21 (Forenoon), Business Meeting—The afternoon program supplied by the Minnesota Federation of Architectural and Engineering Societies, includes Building Stone of Minnesota, John H. Mullen, Geo. M. Shepard, Edwin H. Hewitt; The Architects Small House Service Bureau, Edwin H. Brown; Sewage Disposal in Minnesota, J. A. Childs.

February 22 (Forenoon)—Federation Program, Surveyers and Engineers Society Adjourned; Peat as a Fuel, Max Toltz, H. J. Meyers, F. A. Wildes; The Minnesota Registration Law for Architects, Engineers and Land Surveyers, Paul Doty; Research Work at the University of Minnesota, Dean O. M. Leland; Building Ordinances of the State, Edwin H. Brown, F. G. German, P. E. Stevens.

Afternoon Sectional Meetings—Highway, C. L. Motl, presiding; Municipal, E. H. Curtis, presiding; Draimage, H. B. Roe, presiding.

Evening—The banquet will be held jointly with the Minnesota Federation.

February 23 (Forenoon)—Sectional meetings will be continued as on the previous afternoon.

Afternoon—Report of the nominating committee.

Report of the resolutions committee.

ENGINEERING SOCIETY OF AKRON

The Engineering Society of Akron, Ohio, mechanical section, held a joint meeting with the local section of the American Society of Mechanical Engineers in December. The meeting was addressed by Dexter S. Kimball, dean of Engineering College, Cornell University; and president-elect of the American Society of Mechanical Engineers, on "Various Phases of Engineering Society Activity."

NEW ENGLAND WATER WORKS ASSOCIATION

The annual meeting of this Association was held, as required by the Constitution, at the rooms of the Association, Tremont Temple, on Wednesday, January 11, 1922, at 2 p. m.

No arrangement had been made to provide a program for this date, and it was not expected that a quorum would be present. The meeting was adjourned to Thursday, January 12, 1922, at 1 p. m., at which time the adjourned meeting was opened in the Banquet Room on the ninth floor of the Boston City Club, Somerset street and Ashburton Place, Boston. At this time the regular program was carried through as follows:

11.00 a. m. Meeting of Executive Committee at Headquarters, Tremont Temple. 1.00 p. m. Luncheon was served at the Boston City Club. 2.00 p. m. Business of the Annual Meeting; Report of Tellers of Election; President's address, "Some observations on Water Consumption." Paper—"The Design and Construction of the Gloverville Standpipe," by Frank A. Marston of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The monthly business meeting of January 4 was followed by a four session conference on "The National Housing Problem:" "Broad Economic Phases," Lawrence Veiler, Lawson Purdy, John M. Gries, and John J. Murphy.

January 5th, "Planning and Zoning, etc.," Joseph C. Wagner, B. Antrim-Haldeman, Charles M. Reppert, Charles W. Leavitt (illustrated), and Andrew J. Thomas. "Utilities," E. P. Goodrich, H. M. Pirnie, W. L. Stevenson. and F. G. Hibben (illustrated). "Legislation and Finance," Edward M. Bassett, Arthur C. Comey, Allan Robinson, John Ihlder, and William H. Ham.

The Central Ohio section of the A. S. C. E. elected as president W. F. Jennings and as secretary H. F. Schryver; and the Northeastern section has elected the following officers: chairman, Frank B. Sanborn; vice-chairman, Walter C. Voss; secretary-treasurer, Charles W.

Banks; and members of the executive committee, Leonard C. Wason and James H. Manning. The New York section at its meeting on January 11th considered the topic, "Traffic Handling —Its Engineering as Well as Regulatory Aspects." Addresses were by E. P. Goodrich and Amos Schaeffer.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Several interesting section meetings of the A. S. M. E. were held recently. These included the joint meeting of the Atlanta section with the Affiliated Technical Societies of Atlanta, on January 24; the joint meeting of the Boston section with the American Institute of Electrical Engineers and the American Society of Heating and Ventilating Engineers on the same date, at which was discussed "The Great Lakes-St. Lawrence Tidewater Project;" addresses by W. L. Saunders on "Commercial and Transportation Features of the Project," and Henry deB. Parsons on "Hydro-Electric and Civil Engineering Phases of the Project;" the meeting of the Bridgeport branch on January 26, at which Edmund S. Wolff spoke on "Finance and Engineering," and the meeting of the Detroit section on the 27, at which Major Theodore A. Leisen, of the Detroit water works department, discussed the "City of Detroit Filtration Plant."

The New Britain branch met on January 31, when it was addressed by Pro. L. P. Breckenridge, of the Sheffield Scientific School, Yale, on "The Importance of the Super-Power System to New England."

The Providence Engineering Society, affiliating with the Providence section, A. S. M. E., American Chemical Society, American Institute of Electrical Engineers, American Society of Civil Engineers and American Society for Steel Treating held its sixth annual banquet on January 31 at the Narragansett Hotel. Floyd W. Parsons addressed the meeting on "The Engineer in Public Service," and Daniel A. Mackay discussed "Public Service in the Northwest."

SEATTLE ENGINEERS' CLUB

The Seattle Engineers' Club recently elected the following officers to serve during 1922: President, Stuart Mannel; Vice President, Chester F. Lee; Secretary, Lyman T. Banks; Treasurer, Amos Stater, and members of the Executive Board, J. Thomas Dovey, Ralph S. Druryand and J. F. Pinson.

INDIANA ENGINEERING SOCIETY

The Indiana Engineering Society held its annual meeting at Purdue University, Lafayette, Ind., on January 19 and 20. Among the subjects discussed were the following: "The Future of the Gas and Steam Automobile," Prof. A. C. Staly, Purdue University; "Sphere of Influence of the Society," R. C. Geoman, Indianapolis; "The Engineers' License Law." Prof. R. L. McCormick; "Current Issues for the Engineer," H. O. Garman, Indianapolis; "Sanitary Engineering," Paul Hansen, Chicago; "The Indianapolis Sewage Plant," C. K. Calvert; "The Engineer in Politics," by John Elliott, city engineer, Indianapolis.

GREAT FALLS ENGINEERING SOCIETY

The Great Falls Engineering Society has recently been organized at Great Falls, Mont., with forty charter members. The officers are: President, E. T. Harlow, and Secretary-Treasurer, John S. Roth.

SOCIETY OF INDUSTRIAL ENGINEERS

The Society of Industrial Engineers has elected Joseph W. Roe as president; W. G. Sheehan, of Detroit, secretary, and F. C. Schwedtman, New York, treasurer.

PENNSYLVANIA HIGHWAY CONTRACTORS

Over 100 representatives of firms interested in the State highway contracts attended the second annual meeting of the Association of Pennsylvania Highway Contractors, in Harrisburg, Dec. 16, and heard addresses upon construction methods, supplies and other matters connected with road building. The afternoon session was devoted to discussion of mechanical devices for road construction.

The speakers generally looked for construction on a large scale next year and for much improvement work. Officers elected were:

William D. Hill, Carnegie, president; S. M. Irwin, Philadelphia, vice-president; Lea Hunt, Wilkes-Barre, treasurer; H. H. Wilson, Muncy, and Walter S. Rae, Pittsburg, were elected to the board of governors for one year and E. R. Shenk, Erie; Henry F. Baton, Philadelphia; B. G. Coon, Luzerne, and J. C. Devine, Alliance, Ohio, were chosen vice-presidents.

NEW YORK HIGHWAY COMMISSION CONFERENCE

Superintendents from 57 counties in New York met January 18 for a two-days' conference at the State Commissioner's office, Albany, and discussed various subjects under the chairmanship of William B. Reed, Third Deputy Highway Commissioner. Among the principal subjects there were building and maintenance of farm and market roads, care of earth roads, bridge design and construction, and road maintenance.

Senator Lowman said the people of the state are friendly to taxation for building and maintaining roads and members of the legislature look with favor upon requests for appropriations for extending the highway system. Deputy Commissioner Reed reported that, during the last year, under the Lowman act, 1,100 miles of hard surfaced roads in the rural districts were improved. Earth roads on Long Island were reported to be exceptionally good and were given a rating of 100 per cent. Conditions found in other parts of the state made an average of 65 per cent.

He urged county officials to give more attention to the care of earth roads, suggesting that towns purchase an up-to-date equipment, consisting of tractor and a three way hone.

PERSONALS

Bingham, Clarence A., formerly city manager of Norwood and Waltham, Mass., and Watertown, N. Y., has been chosen city manager of Lima, Ohio.

Windrow, Rollen J., state highway engineer of Texas for the past three years has resigned.

Stanton, Col. Charles E., U. S. A., retired, has been appointed commissioner of public works of San Francisco, Cal.

Mather, Thomas H., has been appointed city engineer of Syracuse to succeed Henry Allen.

Diehl, Thomas R. has been chosen city manager of Westerville, Ohio.

Schmidt, William A., of Johnstown, Pa., has been appointed street commissioner to fill the vacancy by the death of John Kammer.

Stacy, George A., superintendent of the Marlboro, Mass., water and sewer department and former president of the New England Water Works Association, died at his home in Marlboro on December 22nd.

Marsh, John R. has been appointed a member of the Muncie, Ind., board of public works.

Hughes, Earl O., has been appointed director of public service of Van Wert, Ohio, and Patrick O'Mara has been made superintendent of streets.

Hodgson, F. R., of Joplin, Mo., has been appointed assistant engineer to S. Ashcraft, city engineer of Joplin.

Speer, Ray, county engineer of Keweenaw county, Mich., has resigned to accept a position with the Wisconsin state highway department.

Layton, W. A., has been appointed city manager of Salina, Kansas.

Pharr, Leroy, has been appointed city manager of Eastman, Ga.

Saddler, C. Webb, has been appointed city manager of Sandusky, Ohio.

Magley, Frank, has been appointed drainage commissioner of Whitley county, Ind.

Brown, Norman E., has resigned as director of public works of Pittsburgh, Pa., to become vice-president of the Dravo Contracting Co. of Pittsburgh.

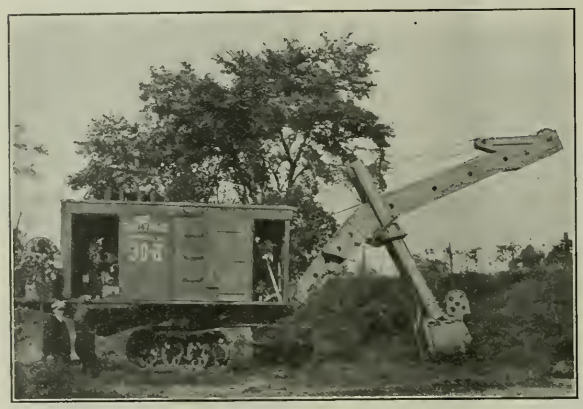
Wills, E. Harold, Mount Holly, N. J., has been appointed county engineer to succeed James Logan who resigned.

Bradshaw, H. J., present city engineer of Stamford, Tex., will assume the duties of city manager to succeed Homer D. Wade who has resigned.

Ackerman, J. Walter, formerly city engineer of Auburn, N. Y., has been appointed city manager of Watertown, N. Y., succeeding C. A. Bingham, resigned.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



GASOLINE OPERATED SHOVEL WITH QUICK REVERSAL AND POWERFUL THRUST

A NEW GASOLINE REVOLVING SHOVEL

A gasoline operated shovel with no engines, motors, shafts, chains or gears on the boom and yet with an actual digging power greater than a steam shovel of the same size is a new development in the manufacture of excavating machinery that has recently been announced by the Bucyrus Company.

This machine, known as the Bucyrus 30-B gasoline shovel, overcomes the serious difficulties of efficient transmission of power to the thrust without excessive complications in design, and the obtaining of digging power commensurate with that of a steam machine of similar size. The manufacturers have also succeeded in obtaining in this new machine the digging characteristics of the steam shovel with its quick reversals, its powerful thrust of the dipper and its dependability.

Before being put on the market, this shovel was successfully used for a period of six months for overcasting and loading dump cars in sticky clay, for grading for a concrete road where the cut averaged 5 inches in old macadam, and for stripping a stone quarry and loading trucks in a stiff hardpan containing many boulders.

It is far simpler than a steam, electric or other types of gasoline shovels and has fewer parts to maintain and keep in order.

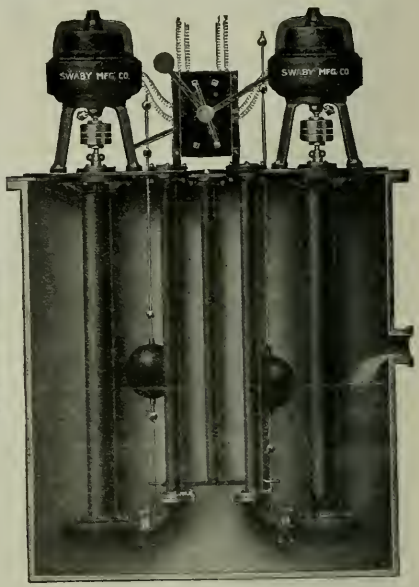
Its digging power is even greater than a steam shovel of the same size.

It has all the well-known performance characteristics of a steam shovel, even to the snaking of the dipper to relieve it of sticky material.

It will give 20 per cent greater yardage per gallon of gasoline than an electric shovel of the same size, or than any other type of shovel whose power is derived from a gasoline engine. This is due to less mechanical loss and less waste energy.

The gasoline engine with which this shovel is equipped is over twice as heavy and rugged as the type of commercal gasoline engine sold for this purpose. It was designed especially for this shovel from specifications offered by the Bucyrus engineers and consequently it is suited for the exacting requirements of this unusually severe service. It is entirely inclosed and thus dust proof, a feature of much importance for excavating work. The engine is a four cylinder, slow speed type and will develop 55 h.p. at a speed of 40 r. p. m.

The shovel carries a 1-yard dipper and may be equipped as a dragline excavator, a crane or a clamshell machine with simple changes which may be made in the field. It fills a long-felt want, for those whose work is in arid regions or where coal is scarce and expensive and feed water of poor character.



DUPLEX BILGE PUMP MOUNTED ON CATCH BASIN

DUPLEX ELECTRICAL CENTRIFUGAL BILGE PUMP

Among the numerous pumps listed by the Swaby Mfg., Co. in the 9th edition of their 1921 catalog of Modern Centrifugal Pumping Machinery there is a duplex electrical centrifugal bilge pump made in three sizes of 60 to 400 gallons per minute capacity for a pit 5 feet deep and 5 feet in diameter and in one size of 300 gallons capacity for a pit 5 feet deep and 6 feet in diameter. Special sizes are built on order with capacity to fit any conditions or any amount of liquid, size of pit, height of delivery, voltage and kind of electric current.

The pumps are entirely automatic in action with floats so arranged that one pump starts operating and if unable to care for the inflow is supplemented by the starting of the second pump, and it operates until the level of the liquid in the catch basin lowers, when the second unit stops automatically and the first unit continues pumping until the basin is empty when it also automatically stops. Thus, for light service, one pump is held in reserve, and for heavy duty both pumps are utilized.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 FEBRUARY 11, 1921 No. 6

North Avenue Viaduct, Milwaukee

Structure 1,385 feet long, 61½ feet wide and 44 feet high, carrying roadway, trolley tracks and sidewalks on retained fill, reinforced concrete and plate girder viaducts and long concrete arch rib spans.

The old four-span steel-truss deck bridge, 40 feet wide, that carried North avenue, Milwaukee, across the Milwaukee river at a height of about 25 feet above water level, has just been replaced by a $710,000 structure, 1,385 feet long, which crosses the river with three two-rib, reinforced concrete arch spans of a total length of 571 feet 7 inches, with 814 feet of plate girder, concrete and retained fill approaches in the axis of the bridge and a 600-foot concrete side approach 28 feet wide at right angles to it. The main structure carries a 40-foot roadway with two trolley tracks and has two 10-foot 9-inch sidewalks and a new elevation that insures a uniform grade over nearly the entire bridge and increases the height of the roadway a maximum amount of about 22 feet 8 inches. The piers and abutments are of concrete, with foundations on solid clay and gravel strata from 12 to 20 feet below the original surface of the ground.

The bridge is a handsome, dignified structure designed to present an attractive appearance and in harmony with the surroundings, to provide abundantly for present and future traffic requirements, and to secure strength and durability with the minimum capitalization for construction and maintenance.

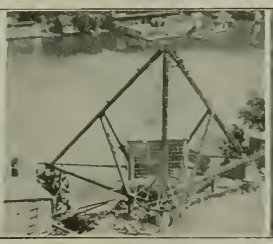
It is of interest on account of the harmonious treatment of the substructure and superstructure, the up-to-date character of construction, and the very successful combination of different types and details of construction to meet varying conditions and requirements for different parts of the structure and still preserve economic relations and secure symmetry of proportions and details.

The bridge was designed and its construction was directed by the Department of Public Works of the city of Milwaukee, of which Percy Braman is Commissioner of Public Works and David M. Keith was acting superintendent of bridges previous to Jan. 1, 1921, since when Manuel Cutler has been superintendent. J. C. Pinney, Jr., acted as consulting engineer. The general contract was awarded Feb. 10, 1920 to Klug & Smith, Milwaukee, and work was commenced July 12, 1920, to be finished within 400 working days after the beginning, under penalty of $500 liquidated damages for every day more than 400 before completion of the work.

The principal estimated quantities include 18,200 cubic yards of excavation, 17,000 yards of concrete, and 182 tons of structural steel. On December 1, 1921, all of the work was completed except paving on the approaches, light post installation, and other minor details and the bridge was open to all traffic on Dec. 15, 1921.

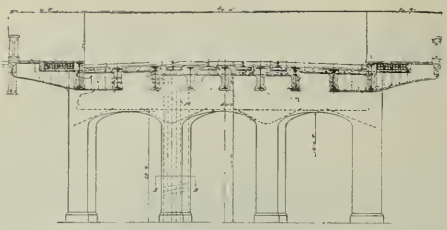
The bridge consists structurally of six sections, beginning at Humboldt avenue, with section No. 1 consisting of about 187 feet of embankment approach retained between concrete side walls of a maximum height of 13½ feet above the surface of the ground.

SAND AND STONE BIN OVER CONCRETE MIXER

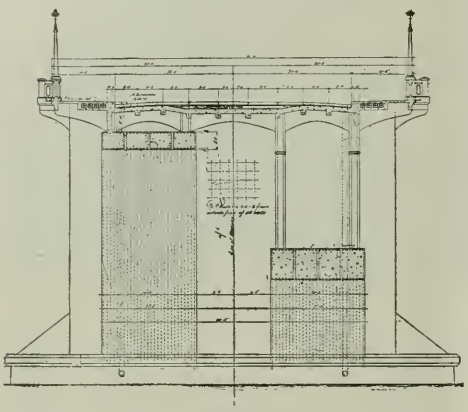


YARD DERRICK UNLOADING AGGREGATE AND CEMENT

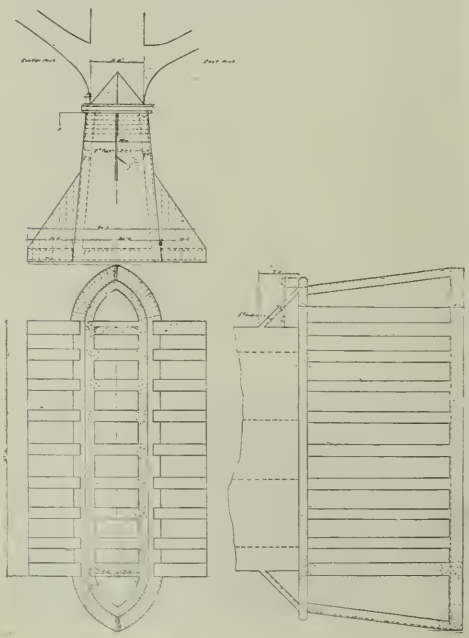
PLACING REINFORCEMENT IN PIER FORM



TRANSVERSE SECTION THROUGH SKEW SPAN OF PLATE GIRDER STRUCTURE



CROSS SECTIONS OF ARCH SPAN AT CROWN AND NEAR SKEW BACK

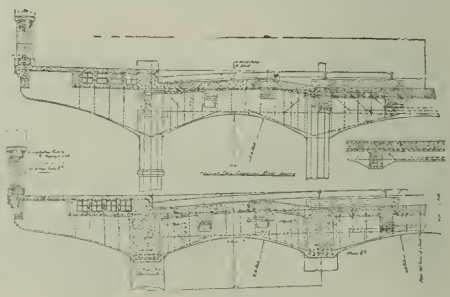


CHANNEL PIER FOR ARCH SPANS

Section 2, about 142 feet long, is of concrete beam and slab construction supported on concrete columns, 35-foot centers. Section 3 carries a roadway over the tracks of the Chicago, Milwaukee & St. Paul Railway and is about 140 feet long with three skewed plate girder spans incased in concrete. Section 4, about 316 feet long, is of concrete beam and slab construction, supported on concrete columns, 33 feet 8 inches centers. Section 5 is a side approach to the viaduct parallel to the axis of the river and is of concrete column, beam and slab construction, 26 feet wide and 600 feet long. Section 6 consists of three arches with clear spans of 155 feet 2 inches, 166 feet 3 inches, and 155 feet 2 inches. The viaduct floor is carried on transverse bents of four columns each and the piers and abutments for the river spans are of hollow reinforced concrete construction.

The first section of the bridge begins at the east line of Humboldt avenue and consists of a retaining wall with earth fill extending about 187 feet east, with a height above the surface of the ground increasing from nothing to about 13½ feet. The fill is retained on one side and one end by reinforced concrete walls 12 inches thick at the top and 16 inches in maximum thickness at the bottom, which are seated on continuous reinforced concrete footings 2 feet thick and having a maximum width of 10 feet. The walls are 18 inches clear of the outer face of the footings, to which each of them is braced by five reinforced buttresses 12 inches thick, on the inner face of the wall, which are imbedded in the fill that covers the upper part of the footing and serves as a counterweight to resist overturning by the horizontal thrust of the embankment. The surface of the fill is entirely covered by a continuous concrete slab 9 inches thick under the roadway and 4 1/2 inches thick for the sidewalks. Under the roadway the concrete slab is depressed to form pockets for receiving street railway ties and rails, concreted between, and the remainder of the roadway area is covered with a sand-cement cushion and paved with sandstone blocks.

The viaduct proper consists of short spans with reinforced concrete floor slabs supported on vertical columns which are arranged in four-column transverse bents, except in the side approach, where the bents have only three columns. Over the tracks of the Chicago, Milwaukee & St. Paul Railway Company the floor is carried on three spans of plate girders incased in concrete, protecting them from the locomotive gases below. The girders have spans of

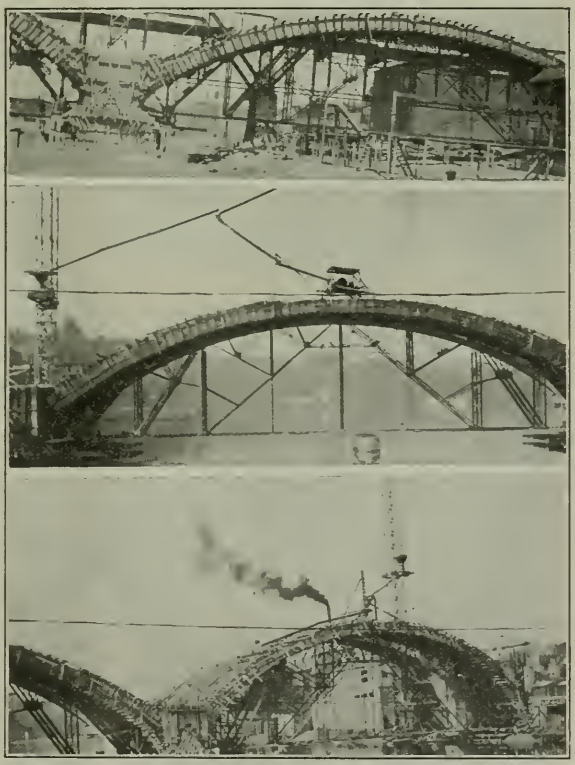


TRANSVERSE SECTION THROUGH VIADUCT FLOOR

44 1/2 feet and those supporting the street car tracks are spaced 5 feet apart, and are 34 inches deep. The curb girders are 40 inches deep and carry the structural steel sidewalk brackets supporting the sidewalks and are incased in concrete. These brackets are virtually extended across the curb girders to the next line of roadway girders, a distance of 5 feet 4½ inches, by structural steel diaphragms incased in concrete and are in the planes of the brackets, engaging the two lines of girders and tending to distribute the cantilever reactions. The plate girders are seated on the reinforced concrete girders, connecting the tops of the viaduct columns and at the ends are provided with expansion bearings. The transverse column bents are parallel to the railroad tracks and make an angle of approximately 45 degrees with the axis of the bridge, thus giving the spans a sharp skew that is taken up by triangular panels of floor construction with each of the panels of the regular viaducts and at both ends. In the remainder of the regular viaduct the spans are 33 feet and 35 feet long on centers, and the roadway slab, 9 inches thick, is carried on stringers and floor beams to reinforced concrete longitudinal girders, supported directly by columns, and on the immediate longitudinal stringers cast integral with the slab, parallel to the main girders and supported on transverse concrete floor beams, connecting the longitudinal girders. Expansion joints in the floor are made with pockets filled with asphalt, and the bearings of the girders and floor slabs are made with tar paper to prevent adhesion between the fixed and moving surfaces.

The arch spans cross the river and are substantially alike except for variations in length. The 164-foot 3-inch center span has a rise of 36 feet, and, like the other arch spans, has two main ribs 16 feet wide and 12½ feet apart in the clear, with three-center curves for the intrados and extrados. The two main radii of the intrados are about 134 feet and 113 feet long. The ribs have crown depths of 3 feet for the center and east span and 2 feet 10 inches for the west span, and those of the center span are reinforced longitudinally near the top and bottom of it with forty-eight 1½-inch diameter bars, assembled with rectangular ½-inch hooping in four sets of 12 bars each. Transversely, near the top of the ribs at the column bases, there are eleven ⅞-inch diameter rods, and throughout the remainder of the ribs there are ⅞-inch diameter rods, 3 feet on centers, alternately top and bottom. The floor slabs are supported on spandrel walls at the crowns of the arches and on two longitudinal rows of the spandrel columns at each

CONTRACTOR'S PLANT, AGGREGATE STORAGE, 220-FOOT STEEL HOISTING TOWER AND SPOUTING SYSTEM



COFFERDAM AND FORMS FOR CHANNEL PIERS BEFORE WATER LEVEL IN RIVER WAS RAISED
CONCRETING RIB FORMS SUPPORTED ON STEEL ARCH CENTER TRUSSES IN MAIN SPAN
220-FOOT HOISTING TOWER AND LOW LEVEL HOPPER AND CHUTES FOR SPOUTING CONCRETE TO FIRST SPAN

side of each rib. The tops of the exterior columns are connected by reinforced fascia girders with curved lower edges giving them an arched appearance. The octagonal columns, 20 inches in diameter, are each reinforced with eight ¾-inch vertical rods and ⅜-inch spiral hooping of 3-inch pitch.

The river piers and abutments are of hollow reinforced concrete construction with longitudinal and transverse vertical walls and diaphragms 30 inches thick and 5 feet apart in the clear, which are braced by exterior buttresses extended to the edges of a wide reinforced concrete footing 3 feet thick.

Snow Clearing in Philadelphia

The storm of January 28th was the most severe, it was reported, that the city of Washington, D. C., had experienced in more than 60 years, and although the intensity diminished towards the north, Philadelphia received a very considerable fall. This gave the municipal forces under Director Caven an opportunity to show what they could do with removal of snow from the city streets. It will be remembered that with the first of this year the municipal forces took charge for the first time of the city's street cleaning. Local papers state that, with all allowance for the fact that Saturday afternoon and Sunday, with their comparative freedom from traffic, were very favorable to the removal of snow, the municipal forces showed a promptness and thoroughness in beginning and completing the job that was conspicuously favorable when compared with work done in previous years by contract. Credit is given to Director Caven for having prepared beforehand an adequate plan of campaign for the snow removal. The first fight was concentrated on the business center and the street crossings all over the city and, as stated, this work was done with a thoroughness and celerity that was unusual for Philadelphia.

Elmira's Water Board Report

The second annual report to reach this office (notice of the first was published in our issue of January 7th) is that of H. M. Beardsley, general manager of the Elmira, N. Y., water board. Mr. Beardsley's report was submitted to the common council on January 16th and a copy reached this office a few days later. This report not only gives the amount of construction work done during the year but also a financial statement including the earnings and expenses and the balance sheet for the year.

As in other cities, the amount of work done was much less than in ordinary times. The largest single item was the laying of a 20-inch line between the main city reservoir and Elmira Heights, with a view to eliminating the excessive cost of pumping water to those heights; which was so successful that it has saved $1,816 in power costs during the five months it was in service. Only 146 services were added and 153 meters.

One interesting item in connection with the department's finances is that in May it purchased $25,000 of its own 4½% bonds at a price which returned it 5½% on the investment, while the bank was paying only 3½%. These bonds have not been retired but are held for re-sale as soon as the board is in position to make some extensive additions to the plant which are thought will be necessary in the near future.

The financial statement shows gross earnings of $202,626 and operating expenses and maintenance of $68,418. In addition there was interest on bonds and on consumers' deposits of $61,891 and deductions made for amortization and taxes of $11,192, while there were non-operating revenues of $4,586. This left surplus earnings of the year of $65,711, of which $35,000 must be used April first of this year in retiring outstanding bonds of that amount.

The balance sheet shows a value of plant and equipment of $1,656,954, while materials, supplies, current assets and other items bring the total assets up to $1,791,140. The outstanding bonds totaled $1,355, while the current liabilities, unamortized premium on debt and reserve for depreciation and compensation insurance add $87,321, leaving a surplus of $348,819.

Systematic Survey of Gravel for Road Purposes

By Wallace F. Purrington, Chemist and Testing Engineer, New Hampshire Highway Department

Excerpts from paper before Convention of American Road Builders' Association —Description of methods employed by New Hampshire Highway Department.

One of the first steps taken at the beginning of our survey was to make a map showing by colors the various areas occupied by different types of rock. This and the direction of glaciation had been worked out by the State Geological Survey under Hitchcock years before. Our success in future lines of investigation was to a great extent dependent upon this very detailed knowledge of the bed-rock and glaciation which was available at the start. * * *

Some of the most valuable information found by the survey of New Hampshire gravels was obtained by making counts of the stone composing each gravel. i.e., the percentage of granite, slate, schist or other rock type. For this purpose, at least 100 pebbles, taken at random, were counted and the results noted. By such a quick and simple measurement of composition it is quite possible to draw conclusions as to the strength of the gravel and so of its value for road purposes. Ordinarily there is not, in any given town, a great difference in the quality of gravel to be found. There are indeed, differences in the proportion of sand, pebbles and cobbles. This is true of the material found even at different points in the same bank. If, when gravel deposits were formed, the force of water with its load of material had been uniform, we might have had homogeneous deposits.

Such was not the case where eskers and kames and other glacial gravel deposits were built, consequently, one hardly knows what is to be found in any part of a deposit that is not visible. To the writer's mind any sample submitted to a laboratory for grading from gravel deposits like these is a mere waste of time. There may be some merit in testing a river of wash plain gravel in this matter, for these are more uniform. Other investigators have reached the same conclusions regarding the absurdity of laboratory grading of samples from glacial gravels. An intelligent manipulation of any pit will give better and more reliable results than any arbitrary grading system that may be devised.

Knowing from field studies, the nature of the deposit, the composition of the gravel as revealed by the stone count, the amount of gravel available and its *probable* grading, the testing laboratory has to pass final judgment upon its value to support traffic. The work carried on by our survey covered nearly 500 samples of gravel, taken at points which represent all the leading geological conditions. A comparison of the laboratory results was made with the count of the stones in every case.

The test used was the Rea modification of the standard Devel Abrasion Test, which modification consists in the addition of six steel balls, used as an abrasive. For the bed-rock, the standard Devel Test was carried on. The actual figures obtained were of course different but the relation between the two tests were similar. In other words, if we found that a certain bed-rock showed a high percent of wear when tested by the Standard Method, we would expect a similar high per cent of wear using the Modified Test on gravels composed chiefly of that type of rock.

As a result of the investigation, the State Highway Department has adopted the following as a specification:

"General.—Gravel shall be composed of fragments of hard, durable rock, the individual particles showing reasonable uniform resistance of abrasion, together with sand or clay or other binding materials.

Physical Properties.— The gravel shall meet the following requirements:*

Class A Gravel-Per cent of wear not more than	7
Class B Gravel-Per cent of wear	7-10
Class C Gravel-per cent of wear	10-15
Class D Gravel-Per cent of wear over	15

Class A and B gravels may be used for either or both base and surface courses; Class C may be used for base course only; and Class D may be used on special written permission of the Commissioner.

This specification is applicable to our conditions. It has been devised after noting the actual road making values of various gravels. It is purely arbitrary, but are limits which we can meet in New Hampshire, but it is appreciated that these values may not be feasible elsewhere.

There can be no question of the valuable to any highway department of a detailed survey of road materials. If the material in any deposit proves to be inferior, it stands to reason that there is a cause for the inferiority. The thorough knowledge of these causes, whether they are conditions of bed-rock or glacial geology should be obtained. For this the employment of a competent geologist is absolutely necessary. No well organized testing laboratory should be without one.

The testing laboratory should become a clearing house of information to which the engineer may refer, as often as new construction projects call for the selection of material anywhere in the state. Turning to the colored geological map the engineer sees at once whether the conditions of bed-rock and glaciation are such as to favor the occurence of strong or weak gravels. Colored pins on the map tell him the locations and general quality (in terms of strength) of all samples already collected and studied from that district. A number on each pin indicates the laboratory test number of that sample. Reference in the files to the cards bearing these numbers affords the more exact record of the stone counts and the abrasion tests. These facts enable the engineer to turn in the right direction in his search for gravel, avoiding loss of time through search where gravels are weak and looking rather for banks where stronger gravels must be expected. If his own knowledge of occurrence of gravel deposits there is incomplete he may call in the geologist for consultation or for a special field reconnaissance. In this way the best sources will not be overlooked. Samples are then collected from the more promising banks. Finally, the tests run on these samples by the laboratory will mainly determine the choice. Questions of amount available, relative economy of operating different banks, etc., will be left to the highway engineer and the administration officer. In short, the process of discovery and selection of gravel is scientific instead of haphazard.

*Tests to be made in accordance with the method described in U. S. Department of Agriculture Bulletin 555, page 301.

Diminished Labor Supply

A report just issued by the Department of Commerce, Bureau of Census, Washington, gives in detail the number of men employed for pay in the State of New York as 3,020,158 in 1910 and as 3,367,907 in 1920, showing a too small increase of only about 10%, while in some of the very important classes there has been a very serious decrease. Brick and stone masons decreased during this period from 28,300 to 19,676; farm laborers from 144,535 to 87,085 and building laborers and unclassified laborers from 88,559 to 50,521, thus accounting for the serious shortage that will become much more important as the drastic restrictions of immigration take effect.

Common and farm labor and masons are among the most numerous of immigrants and have always been relied upon for the necessary supply. The present deficiency, besides directly increasing wages, very much hampers the operations and reduces the efficiency of mechanics, retards all kinds of construction operations and is both directly and indirectly a serious factor in maintaining the high prices that discourage construction and are the principal reasons for the alleged unemployment.

Progress of the Pittsburg Road Tests

By Charles W. Geiger

Some sections of the road are giving way at spots, and these are being made passable by concrete blocks and planks so that the test can continue until all are broken up. No appreciable abrasion of surface.

According to engineers who are in charge of the test highway at Pittsburg, the concrete track is holding up in an exceptional fashion under the strain to which it has been subjected during the past weeks. Some sections of the highway, however, are beginning to show signs of breaking down, but this is not to be wondered at. While there are actually only about forty trucks in the service of the experiment makers, these are being run so constantly during the eight working hours of the day that it is figured that approximately 1,500 heavily loaded trucks a day pass over any given point on the oval highway. As there are about 30,000 motor truck in service in the entire state, it can readily be seen what heavy traffic is being concentrated on the highway to find out what type of concrete road construction will best stand the unusual strain of heavy haulage. It is further made clear that there is no indictment of the truck intended in the Pittsburg experiment, for the present laws regulating motor trucks are deemed ample to protect the highways from abuse.

On December 21 the side ditches of the highway were flooded and samples of the subgrade were taken on December 30. It is evident that the original subgrade was so compact that it is practically impervious to water, and it is not thought that it will become saturated except through the medium of suction under the slab pavement.

Lloyd B. Aldrich, engineer in charge of the tests, and his assistants are taking careful note of the conditions of the thirteen sections comprising the oval, noting how each type has withstood the traffic, but they will not be able to make a thorough or complete report until the series of experiments has been entirely completed.

During January more than 200 delegates representing the boards of supervisors of many of the California counties, county engineers, and members of the San Francisco Automobile Dealers' Association gathered at the Pittsburg track to observe the manner in which the highway is standing up. It was planned to give all the visitors a most intimate understanding of the construction and tests that are being made, and in order to do this motion pictures were shown, revealing in detail the process employed from the mixing of the concrete to the completion of the road. These moving pictures also showed the system devised for recording road shocks, impacts and other features. Moving pictures have been taken and will continue to be taken of the tests until the experiments are completed. The moving picture operator succeeded in photographing a section which happened to break under the impact of the truck wheels while the picture was being taken, which is considered very fortunate.

Moving pictures were taken of the Ames dials as the trucks were run over the impact planks placed across the track over the tunnel, and the action of the hand on the dial was shown very clearly.

Up to and including January 2, trucks running over the highway had aggregated 75,866 travel miles, while a total weight of 2,691,490 tons had passed over each slab which forms part of the roadbed.

As the weaker sections break up, the breaks are repaired, as shown in some of the accompanying

TEST HIGHWAY FLOODED—THE TRUCK NEAREST THE FOREGROUND IS JUST PASSING A BREAK IN SECTION H.

photos. The broken concrete is removed and an excavation made to a depth of 16 inches below the surface of the concrete pavement. Timbers 4 inches square are placed on the bottom of the excavation and on these are placed timbers 12 inches square, thus bringing the top of the timbers on a level with the surface of the concrete pavement. In one break, concrete blocks about 6 inches thick were used in making repairs. This proved very satisfactory and is shown in one of the photographs.

The evidence of traffic wearing away the concrete surface has been lacking. In fact, in the straight sections of the road no appreciable evidence of wear can be seen.

SCOPE OF TESTS*

The following tests were planned and have been developed up to date:

1. Static load, moving load and impact deflections in the slabs overlying the four observation tunnels. These are taken for a single loaded truck at various positions of the slab.
2. Impact deflection on one tunnel under a loaded touring car with various heights of drop and varying speed.
3. Same tests as noted in No. 1 except that two loaded trucks were used.
4. Temperature movement of slab.
   a. By observation (Ames dials) within the tunnels.
   b. By Ames dial readings from the slabs to iron rods driven 3 feet into the subgrade.
5. Temperature variations in the top and bottom of slabs in comparison with atmospheric temperatures.
6. Same tests as noted in No. 1, taking in addition the subgrade deflection as measured by Ames dials, reading from rods extending from plates just underneath the slab to the tunnels.
7. Extensometer measurements of strain in the pavement slab due to a loaded truck. These measurements taken simultaneously with vertical deflection readings in the tunnels with the purpose of obtaining a check on any analysis of stress in pavements which may be devised from these tests. Strain measurements and vertical deflection also taken at corners.
8. Laboratory tests of subgrade:
   a. Chemical analysis.
   b. Physical analysis.
   c. Moisture determination at various times and places.
9. Tests on materials entering into pavement:
   a. Aggregate tests.
   b. Cement tests.
   c. Tests on steel.
10. Tests on concrete:
   a. Compression tests of 5″ and 12″ cylinders.
   b. Tests for modulus of rupture.
   c. Tests of reinforced beams to show difference between beams reinforced with high tensile and structural steel.
11. Scale measurements of the opening of pavement cracks.
12. Traffic test subjecting all sections to regulated truck traffic. This test is proceeding with variations in loads and subgrade moisture content until complete failure of all sections, if this is feasible.

STATIC LOAD, MOVING LOAD AND IMPACT DEFLECTION TESTS

For making these tests, there are used the tunnels and contained apparatus described in the issue of Public Works for October 29, 1921.

By means of this equipment, deflection readings were taken as follows: The truck was started with its right hand wheels over the outside rods. As soon as the effect of the load was noted on the dials, the truck was stopped and readings taken on all rods. Then the truck was moved ahead two or three feet and similar readings taken. These were plotted in the form of an influence line for each rod. The moving and impact readings were obtained by reading the maximum deflection as the load went over. This maximum was accurately determined by means of a friction sleeve sliding on the rod fastened to the dial.

These tests were run before any real traffic was put on the highway and have been followed up at intervals since the traffic commenced, to see what effect the traffic might have on these results. The following notes in respect to these tests may be of interest:

1. On all slabs tested the effect of the load was felt from the time the front wheels reached a point 10 to 14 feet from the tunnel.
2. The first deflection noted almost invariably

*For the following information the author is indebted to Mr. Farmer, one of the Government engineers stationed at the test highway.

MEASURING VERTICAL MOVEMENT OF EDGE OF CONCRETE SLAB

REPAIRING BREAK BETWEEN SECTIONS L AND M. CONCRETE HAS BEEN REMOVED. STEEL REINFORCING IS SHOWN TURNED INTO VERTICAL POSITION

was a negative reading. The amount of this was from .0001 to .0008 inch but was readily discernible.

3. After the effect of the passing load was complete there was usually left a residual reading on the dials. This would be gradually reduced until in from one to two hours it would be almost entirely lost. If the test were run immediately after the cessation of traffic this set was practically negligible.

4. Up to the time traffic was started, the moving load deflection was slightly less than static load deflection.

5. Relative temperature of top and bottom of the slab alter very appreciably the deflection under identical loading conditions.

6. Movement of the subgrade as measured by the soil rods just described indicates that the subgrade movement is very much less than the slab deflection. It varies from approximately 20 per cent. of the slab movement at the edges to 50 per cent near the center of the slab. Subgrade deflection begins with the first indication of slab deflection and ends likewise. No satisfactory explanation yet offered.

7. Deflections of slab were run under two trucks, both going in same direction and with the trucks passing. No appreciable difference in the deflection readings could be detected.

8. In order to settle the question as to whether the deflection readings relative to the brackets in the tunnels were absolute, holes were bored in the bottom of the tunnels and pipes driven three feet into the subgrade. Inside these, rods were driven into the subgrade and deflection readings taken relative to these. Results showed a discrepancy of from 5 to 10 per cent. Probably a greater discrepancy at greater depths.

TEMPERATURE MOVEMENT OF SLAB

These movements have been studied by means of the two methods outlined. In the first method, the dials were all set at zero on the brackets and read during a period of 24 hours. Readings were taken at 2-hour intervals together with atmospheric temperatures and slab temperatures.

In the second method, holes were drilled in the header boards and at construction ⅜-inch rods 3 feet long were driven into the subgrade. The tops were approximately ½ in. below the surface of the slab. An Ames dial was affixed to a rigid base having three legs in such a manner that the propeller rod would just touch these driven rods when the above mentioned base was resting on the slab as shown in the accompanying photograph. A definite mark was made so that the base could always be placed at the same point on the slab. By this means the slab movements were studied at various sections around the highway. Readings were taken, at regular times. The same movement as noted in the first method was observed. The diagram shows the movement of the slab, and also shows how transverse cracks appear at the top of the waves in the pavement.

A third method was tried of using a lattice girder similar to the method used on the Bates road. This girder spanned the road and was supported on 4″x6″ posts planted in the shoulders. The girder was composed of 2½x2½x¼ angles spaced 18 inches.

The effect of varying temperature on this girder was found to have a large effect on the readings, such as to nullify the value of the experiment. It was suggested that, by using two identical girders and taking Ames dial readings from one to the slab and from the other to rods driven into the earth, very close net readings could be obtained. Both girders should be pointed in the same direction. This has not as yet been tried.

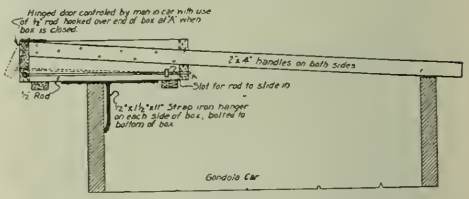
(To be continued)

Car Unloading Device

The accompanying engraving illustrates the hopper used for unloading cars of broken stone mentioned in the article on the Bankhead Highway, published on page 47, January 21st.

The hoppers of 12 cubic feet capacity were of simple construction and semi-automatic in operation. They involved no special materials or fittings, can be quickly and cheaply built by any contractor, and reduce time, cost and diffculty of unloading gondolas or other open-ton box cars, containing loose materials like stone, gravel or coal that have to be shoveled over the side by hand. The hoppers are so inexpensive that one can be provided for every car on the siding, enabling them to be simultaneously unloaded and obviating the necessity of delay or shifting.

The hopper consists substantially of a rectangular wooden skip which, in service, is balanced on the edge of the car side with the outer end overhanging the truck, wagon or batch box into which the material is to be dumped.


Hinged door controled by man in car with use of ½" rod hooked over end of box at A when box is closed.
2"x4" handles on both sides
Slot for rod to slide in
½" Rod
12"x1½"x11" Strap iron hanger on each side of box, bolted to bottom of box
Gondola Car
Inside dimensions of box 3'-6"x6'-5" constructed of 2" lumber

TILTING BOX FOR UNLOADING CAR BY HAND

The hopper is retained in position on the narrow edge of the car by a pair of bent steel lugs bolted to the bottom and engaging the inside of the car by a vertical projecting rib that prevents sliding outward and holds the skip in position as it revolves into the inclined dumping position.

The skip is supported just outside the center of gravity, causing a tendency for it to revolve downward into the car, which tendency is overcome by a pair of long horizontal handles bolted to the sides of the skip and resting at their extremities on the opposite side of the car.

This gives the skip stability while loading, after which the outer side is unlocked by releasing the latch rod A, and it is dumped by hand by lifting the extremities of the handles and thus easily overcoming its slightly overbalanced counter weight. The dumping requires only a few seconds, the skip returns to loading position by gravity without requiring adjustment, and the unloading will go on continuously with much less effort than is required for shoveling the material over the side and into the truck.

PUBLIC WORKS

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Neglect of Water Purification Plants

The conditions found in water filtration plants in Iowa, as told by Mr. Hinman in a paper abstracted in last week's issue, are by no means confined to that state but may be found probably in every state where small water purification plants exist. Large purification plants are generally in charge of trained and responsible operators and their importance because of the large numbers of citizens depending upon them would tend to secure a closer supervision by the state health department. But the smaller plants are often in charge of men without technical knowledge or skill and insufficiently impressed with the importance of the continuous effective operation of the plant.

Investigations made by state health boards or others following typhoid epidemics have revealed on several occasions that those in charge of the water works had served raw polluted water to the citizens during a temporary break-down of the plant or other interruptions of its operation, sometimes without any notification whatever to the citizens with instructions that the water be boiled during the emergency. An instance has recently come to the writer's attention of a small plant for filtering and disinfecting a supply subject to pollution, the operation of which plant was entirely discontinued during the cold weather because, in the absence of any method of heating the building, there was danger that the chemical equipment would freeze.

In states where there are scores of small plants, it is impracticable for the state health officials to keep constant watch of all of them. It would seem, however, as though the officials or private companies having charge of such plants would feel a moral responsibility that would restrain them from any such negligence or deliberate failure to protect the consumers. The failure of a plant temporarily to produce satisfactory results may be due sometimes to unknown or unforseeable conditions and in some cases may be excusable; but the deliberate omission of acts known to be essential to securing the safety of the supply should be made a crime and subject the responsible officials to severe punishment.

We believe that most sanitarians will agree that there is more danger in the occasional omission of precautions which have become a regular feature of a supply than there would be in the continuous furnishing of such a supply without treatment, in that the regular consumption of a polluted supply brings with it a certain immunity to the regular consumers thereof, which immunity is gradually lost by the consumers after months or years of habitual use of a practically sterilized water.

Whether this idea of immunity is admitted or not, the fact remains that present knowledge of the causes of disease renders it unthinkable that a civilized community should countenance the deliberate serving of polluted water to the consumers of any water supply. Much can possibly be done to prevent this by educating the small communities to an appreciation of the importance of the uninterrupted operation of plants installed for purifying the supplies on which they depend, and it would seem desirable for state health boards to secure the co-operation of the newspapers of their states, and especially those of the smaller communities, in keeping this idea before the citizens of such communities. In addition, as stated above, it seems to us that deliberate failure to operate such purification plants should be made punishable by state law.

Paving Assessments

The monthly publication of the National Municipal League for February is devoted to a discussion of "Special Assessments" to "meet the demand for information on special assessment administration." It discusses the distribution of costs and methods of assessing improvements of various kinds, chiefly improvements of street surface, sewers, parks and public utilities. Most states and cities recognize the principle of assessing for improvements of one kind or another, but the method of assessing and the distribution of the cost is by no means uniform in all states, nor by all of the cities in most of the states, although some have adopted state laws requiring prescribed methods.

It has been our practice for several years to collect, during the first month of the year, data concerning street paving, and this year we included in our questionnaire questions concerning the methods of assessing for paving employed in the different cities. These and other statistics connected with paving will be published in the issue of February 18th and a number of succeeding issues (since the amount of material collected is too great to be included in a single issue), and those municipal officials, either engineers or members of commissions or councils, who are interested in the financing of street improvements will find in the articles based

upon these data valuable information from 700 or 800 cities and towns in all states of the country, sufficient to give a very complete idea of the relative popularity of the various methods employed.

Sewage Treatment in Imhoff Tanks*

By Russell Riker

Foaming in tanks and experiences in trying to control it—Seeding or inoculation, breaking up scum and others—Chemical analyses of sewage and sludge.

FOAMING AND ITS CONTROL

Not only in this state have operators experienced such trouble with foaming, but it seems to be universal throughout the country. The experience at Baltimore has already been commented upon by Thomas D. Pitts, in which he states: "I do not believe that the Imhoff tanks will prove satisfactory for any plant which has to handle quantities of sewage approximating ours." He further states that his belief is due chiefly to the increased cost for maintenance and operation which has been experienced at the Back River plant. The layer of scum which formed on the surface of the tanks was so deep that it frequently extended below the surface of the baffles and the tank had to be put out of service until the scum sank or was skimmed off.

A great many engineers, including Dr. Imhoff, later condemned the downward and upward flow tank, so that this feature was eliminated from two of the Baltimore units and these placed in operation in May, 1919, and in the fall of 1920 two other units had been changed in the same manner and placed in operation. In December, those tanks which had been altered and operated during the previous summer began to foam and investigation showed that scum had filled the gas vents completely from the surface to the level of the slot.

At the Albany plant in the summer of 1920 there was very little trouble due to foaming. Several of the gas vents overflowed, but upon changing the direction of flow the foam in the gas vents ceased. Early in the spring of 1921 it was noticed that considerable belching was taking place in the flowing through compartment, although the operator was quite certain that the sludge in the bottom did not reach the level of the slot. It is thought that gas laden sludge was coming up through the slot due to the fact that gas vents were already filled to capacity. It is also understood that the tanks at Columbus, Ohio, have recently passed through a period of foaming, which the operator has been unable to cope with.

A great many of the operators of the large plants state that foaming can be controlled by reversing the flow and drawing sludge. This practice has been tried in New Jersey with considerable success and the operators have been advised to draw sludge more frequently in small quantities. Care must be taken, however, not to follow the experience of the Oaklyn operator in drawing too much sludge.

In addition to the above, experience has shown that it is not advisable to use too much water in keeping the foam down. Only enough water should be used to loosen the scum and then it should be agitated by paddling. Shutting off the flow of raw sewage into the tank and allowing it to rest until satisfactory bacterial action has again started in the tanks is also an admirable method of operation, but this cannot always be accomplished where the capacity of the plant is small or where there is only one unit at the plant. Lime has been used by some operators with success, particularly when starting the tank, but in a few cases it has resulted in the production of a very offensive sludge. Where the sludge is already alkaline it may be of some benefit in reducing the formation of gases by chemical composition with them.

Foaming may be attacked from two different angles; one from a bacteriological standpoint—inoculation, and the other by a mechanical breaking up of the foam.

Seeding. Considerable work has been done on seeding tanks before placing them in operation. The most important experiments were carried on at Baltimore, where successive tanks were seeded with purified sewage, digested sludge, newspapers and lime. Scum formed in all the tanks and overflowed the gas vents, although it may be said in defense of one tank, seeded with newspapers and ripe sludge, that the foaming was not as intensive as in the others.

Seeding was tried out at Plainfield, N. J., in 1916, but without marked success. Our experience would indicate that it may have a beneficial effect but that foaming will and has occurred even when the tank has been well seeded with ripe sludge. It is probable that ordinary bacterial decomposition overcame enzyme action. The only object of inoculation would be to supply an abundance of enzymes after an alkaline reaction has been established.

Breaking up Scum. A means for mechanically breaking up the scum in the gas vents has been instituted at Austin, Tex. This control device consists of a 12-inch cast iron pipe centered in the gas outlet, with its top about 12 inches above the sewage line and its bottom at about the level of the slots in the settling chamber. Both the top and bottom of the pipe are open, but at the bottom a gas deflector is hung to prevent gases from ascending through the pipe. Water under pressure is sprayed into the top of the cast iron pipe, should foaming occur, to break up and carry down the scum and floating sludge. It seems quite practicable except in those cases where the entire depth from the top of the gas vent to the bottom of the sludge chamber is filled with viscous floating sludge.

Another method suggested by Leslie C. Frank, of the U. S. Public Health Service, to cut down scum formation or rather to produce better sludge, consists of circulating the bottom sludge. Where it is necessary to pump the sludge from the bottom of the tank in order to discharge on the sludge bed and where a circular tank is to be constructed, this system is very simple and can be constructed with little additional expense. It consists of a compressed air system for removing the sludge. Valves

*Concluded from page 91.

and piping are so arranged that the sludge outlet pipe can be shut off and the bottom sludge returned via the gas vents. It is well to introduce the sludge in a circumferential direction in the scum chamber so as to produce rotation. Projects may be inserted on the inside wall of the circular scum chamber so as to produce revolving eddies. This would be equivalent to having a number of sludge valves discharging on the scum surface. Such an apparatus is now in operation at Tenack, New Jersey.

It is thought that a very fine spray is very effective in breaking up the bubbles as they reach the surface, but care must be taken not to add too much water to the foam.

The construction of a screen in the gas vents to keep the scum water-logged has not proved successful. The addition of oil (kerosene) to the gas vents is not entirely successful, although good results can be obtained from it for a short period. Agitating the sludge with paddles is the most effective.

CHEMICAL ANALYSIS OF SEWAGE AND SLUDGE

Although many analyses have been made by the Department of Health of this state of the raw sewage, the settled sewage, and of the sludge and scum in Imhoff tanks, no helpful information has been gained from them with perhaps the exception of the analysis for fats.

sewage after leaving the tank the better it can be treated by secondary purification. It is better not to return to the old septic tank tank treatment of sewage, where very stale, offensive septic sewage is discharged from the tank, but it is believed that a number of one-story settling tanks operated in rotation will give equally as good results as the two-story tank with much less operating expense. In fact, such installations installed in New Jersey, where the tanks are turned off as soon as the effluent begins to become charged with suspended matter and the settled sludge allowed to digest for a certain period of time, results have been very satisfactory.

In closing this discussion, we would advise any municipality that intends to install a sewage treatment plant, to first consider carefully before deciding upon the use of Imhoff tanks for settling purposes. It is admitted that all methods of sewage treatment have their disadvantages and that no one method has proved satisfactory for all conditions, but it is thought that the time has arrived when the promiscuous installations of Imhoff tanks should cease. The art of sewage treatment has advanced rapidly during the last few years, so rapidly that sufficient study has not been made upon any one method to determine its advisability under different conditions.

ANALYSIS OF SLUDGE
FROM LARGER IMHOFF TANKS IN NEW JERSEY

Plant	Appearance of Sludge	Alkalinity	WET SLUDGE % Water Contain.	WET SLUDGE % Dry Material	WET SLUDGE % Fats	DRY MATERIAL % Mineral Matter	DRY MATERIAL % Organic Matter	DRY MATERIAL % Fats	Odor
Chatham-Madison	Dark Gray	Slightly Alkaline	94.21	5.79	0.956	44.57	55.43	16.51	Rubber
Hammonton	Dark Gray	Slightly Alkaline	88.79	11.21	1.540	52.46	47.54	13.74	Musty
Plainfield	Gray	Highly Acid	87.52	12.48	1.492	27.49	72.51	11.16	H_2S
Princeton	Black	Alkaline	93.92	6.08	0.416	37.89	62.11	6.91	Musty
Vernon	Black Grained	Highly Alkaline	91.94	8.06	0.752	41.19	58.81	9.33	Tar
Westfield	Black	Highly Alkaline			0.828				Rubber

NOTE: Plainfield sludge has turned alkaline since this analysis and its physical condition has improved.

It would seem that those plants that contain the smallest amount of fats in the sludge have better sludge digestion. We have found that in many cases plants that were foaming or contained an excessive amount of sludge in the gas vents contained a sludge which analyzed better than plants that were working in a normal condition. The alkalinity of the raw sewage is quite important in order to determine whether to add lime, and the water content of the sludge is also of importance, but complete analysis of the sludge and scum has revealed very little helpful information.

It is believed that the principle of separate sludge digestion is an excellent one and that the method of having a separate tank for the sludge digestion can be improved so that many of the inconvenient factors now entering into the operation can be smoothed out. One very valuable result has been obtained from the operation of the Imhoff tank; that is, knowledge that long periods of detention in the settling chamber are not necessary. The fresher the

Iowa Road Construction

During 1921 the work done by the Iowa State Highway Commission included 165 miles of paving, 368 miles of gravel and 1,051 miles of grading, a record that it is expected will be excelled in 1922, when there will probably be 1,500 miles of construction finished, embracing 100 miles of paving and 500 miles of gravel surfacing.

Hard surfacing for this primary road systems has already been authorized by 27 counties and 13 of them during 1919 authorized $18,475,000 bond issues.

AVERAGE COST OF HIGHWAY CONSTRUCTION IN IOWA IN 1921

Type of Road	Let in 1921 or held over from previous years	Construction in 1921	Average Cost per mile
Bituminous Filled Brick..	18.35	13.44	$58,100
One Course Concrete....	152.67	151.92	$40,700
Bituminous Penetration Macadam	8.57	6.04	$20,195
Gravel surfacing	501.79	361.65	$ 2,500
Earth Roads	1,464.15	1,050.88	$ 3,300

Recent Legal Decisions

CLOSING OF STREET FROM CURB TO CURB FOR PARKING PURPOSES NOT AN ABANDONMENT OF THE STREET

A property owner claiming the fee of a street from property line to property line claimed the erection by the municipality of a concrete bulkhead from curb to curb of the street to be a physical closing of the street amounting to an actual abandonment by the city. It was held Keller v. City of Oakland (Cal. App.) 201 Pac. 618, that, since only a part of the street was closed by the bulkhead, and it was apparent from an ordinance setting apart part of the street for parking purposes that the relinquishment of a portion of the street was not a permanent relinquishment, and was made upon the condition that it was to be revocable at will by the city, the municipality's act was not an abandonment of the street.

BUILDING ORDINANCE HELD VALID

An ordinance of a city in Nebraska required the submission of plans and specification and the obtaining of a building permit from the building inspector to be granted by him only after careful inspection of the plans and specifications, and his findings that the building will be of sufficient strength and with proper means of ingress and egress, the permit to be subject to revocation by the city council if the work is not done according to the application for permit. The Nebraska Supreme Court holds, James H. Daily estate v. City of Lincoln, 185 N. W. 332, that the ordinance is general and uniform in its provisions, and does not grant arbitrary powers to the building inspector and city council, and is not, for that reason unconstitutional. A building ordinance regulating the kind of buildings to be erected, and requiring the construction thereof according to the plans and specifications and with the spirit and letter of the ordinance, would be a nullity, unless power was given to determine whether the proposed building was in conformity therewith, and to require construction in conformity to the plans and specifications, and the power to cancel a permit if not so built. The city council might have reserved these rights to itself or might delegate the power, as in the instant case, to the building inspector * * * The courts are quite uniform in holding that building ordinances that do not prescribe a general or uniform rule for building, and vest the power to grant a permit in a building inspector, are unconstitutional in conferring arbitrary powers upon the person clothed with authority to grant a permit. Such an ordinance might subject the property owner to the arbitrary will of the inspector. The ordinance in question grants no such arbitrary power to the building inspector * * *"

CONTRACTOR HELD NOT ENTITLED TO CHARGE FOR EXTRAS WHERE TERMS OF CONTRACT THEREFOR NOT FOLLOWED

A municipal contract provided that: "No extra work will be paid for or allowed unless the same was done upon the written order of the engineer. . . All claims for extra work must be made to the engineer in writing before the payment of the next succeeding estimate after the work shall have been performed, and failing to do this the contractor shall be considered as having abandoned his claim." In an action by the contractor for extras, it was held, Nelson v. City of Eau Claire (Wis.), 186 N. W., 168, that a claim for extras was demurrable under the pleadings and the terms of the contract, where there was no allegation that the extras were furnished upon the written order of the engineer, or that claims were made in writing therefor before payment of the next succeeding estimate.

PREPARATION FOR BUILDING UNDER PERMITS DOES NOT PREVENT INCLUSION WITHIN FIRE LIMITS BY SUBSEQUENT ORDINANCE

The Arkansas Supreme Court holds, Wilder v. City of Little Rock, 234 S. W., 479, that the fact that the receiver of a permit to construct a wooden building outside the existing fire limits acquired the property and made preparations for constructing the building under the permit prior to the passing of a new ordinance extending the fire limits so as to include the site of the intended building, did not give the holder of the permit any vested rights authorizing him to restrain interference with the construction of the building.

EFFECT OF FAILURE IN REQUIRED PRESSURE ON RECOVERY OF RATES FOR FIRE PROTECTION SERVICE

The Borough of Ridgefield, N. J., is supplied with fire protection service by the Hackensack Water Company from three sources, the Weehawken high district, the Englewood high district, and the New Milford low district. In a suit by the water company to recover for the fire protection service at the rates prescribed by the Board of Public Utility Commissioners, the New Jersey Court of Errors and Appeals holds, Hackensack Water Co. v. Mayor, etc., of Borough of Ridgefield, 115 Atl. 399, that the fact that part of the Borough supplied from the New Milford low district was not furnished with water at the required pressure and quantity is a defense for the borough so far as regards the rates for that portion of the borough not properly supplied; the rates from each source being a matter of calculation for each portion of the service. It was not error for the trial court to direct a verdict for the water company for the rates in that portion of the borough where the service had been furnished.

CITY NOT LIABLE FOR INJURY TO CHILD BY NAIL IN PLANK PLACED IN STREET

A heavy plank was removed from a defective culvert and laid in the bottom of a ditch at the side of a street by property owners. A child playing in the street lifted one end of the plank and let it fall in such a manner that a nail in the plank pierced its foot. The Minnesota Supreme Court holds, Spiering v. City of Hutchinson, 185 U. W. 375, that the city was not chargeable with negligence in failing to foresee and guard against such an unlikely occurrence.

NEWS OF THE SOCIETIES

CALENDAR

Feb. 12-17—CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13—ENGINEERS' CLUB OF BOSTON. Boston, Mass.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention Cleveland. Secretary Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Automobile Club of America. New York City.

Feb. 14—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago, Ill.

Feb. 14—THE NEW ENGLAND WATER WORKS ASSOCIATION. Boston City Club, F. J. Gifford, Sec., 715 Tremost Temple, Boston.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO, Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15—NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. New York City.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies Bldg., New York City.

Feb. 15-18—NEW JERSEY STATE HIGHWAY COMMISSION. Second annual meeting. Trenton, N. J.

Feb. 17—NEW JERSEY SEWAGE WORKS ASSOCIATION. Annual meeting. State House, Trenton, N. J.

Feb. 20-23—NATIONAL ASSOCIATION OF BUILDERS' EXCHANGES. Annual meeting. Hotel Chisca, Memphis, Tenn.

Feb. 20-23—AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Engineering Societies Bldg., New York City. Secretary, F. F. Sharpless, 29 W. 39th st., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23—MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention. Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN ASSOCIATION OF ENGINEERS. Conference of practicing engineers. Congress Hotel, Chicago.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Feb. 24-25—ENGINEERING SOCIETY OF WISCONSIN. Annual meeting. Madison. Secretary — L. E. Smith, Madison.

Mar. 14-16—AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual convention. Chicago, Ill.

Mar. 15—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Mar. 18—ROCHESTER ENGINEERING SOCIETY. Quarter-centennial dinner.

Mar. 23-24—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting. Urbana, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Masillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATER-WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The February meeting of this association will be held at the Boston City City, February 14th, 1922.

Program: 11.00 a. m., meeting of executive committee at the headquarters, Tremont Temple; 1.00 p. m. luncheon at the Boston City Club.

2.00 p. m., paper: "The Proposed Extension of the Metropolitan Water Supply," by X. H. Goodnough, chief engineer, Massachusetts Department of Public Health, Boston, Mass., illustrated; will discuss the resources of the present metropolitan system, the necessity of immediate extension, and will describe the additional works proposed. Time permitting, discussion will be had on one of the following practical subjects: "Carrying Cast Iron Pipes Through Foundation Walls"; "Use of Extension Stems Over All Street Gates"; "Operation of Distribution System with Valves Partially Closed."

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular business meeting, February 1, Col. John P. Hogan presented a paper on the "Past and Predicted Growth of Power Demand in New York State." It covered the salient points in the development of the most important essential to any extensive power project—a market—as it relates to the greatest urban development in the country and was illustrated by lantern slides.

NEW YORK SECTION, A. S. C. E.

The subject of the meeting of this section held in New York on December 21st, was zoning, and what it has done for New York. The matter was discussed by Edward M. Basset, John B. Fox, Rudolpn P. Miller, Clarence S. Stein and others, and the points brought out were the protection of residence and retail districts, the curbing of skyscrapers, and the need of decentralization of the city's industries.

THE NATIONAL CIVIC FEDERATION

The twenty-second annual meeting was opened in New York, January 29, former Judge Alton B. Parker presiding. The federation is composed of leading employers, labor union officials and a group representing the public.

Among the principal subjects discussed were the right of railroad and other public utility workers to strike, the advisability of establishing tribunals possessing the power to compel arbitration and submission to the consequent awards, and the use of injunctions in capital and labor disputes.

Former Governor Ben W. Hooper, vice-chairman of the United States Railroad Labor Board, advocated extension of the board's powers to compel obedience to its decisions; Glenn E. Plumb, representing the Railroad Employees' Department of the American Federation of Labor, wanted the board abolished. Samuel Gompers joined in attacking the Hooper contentions and contended that compulsory arbitration means compulsory labor.

Matthew Woll, international president of the Photo Engravers' Union, declared that the courts, including the Supreme Court of the United States, violated the constitutional rights of the workers in some of their decisions, especially in the matter of injunctions. Judge Parker asserted that the Federal courts had not seized any judicial powers which the Constitution did not intend them to have.

Governor Hooper denounced strikes as a means of settling railway labor controversies, terming them "economic war."

Mr. Plumb attacked all industrial court theories based on the Allen law of Kansas.

Mr. Gompers denounced court and other efforts which, he said, were being made to bring about compulsory labor.

BROOKLYN ENGINEERS' CLUB

At the meeting of January 26, a paper on The Plans of the Port of New York Authority, illustrated by lantern slides, was presented by B. F. Cresson, Jr., chief engineer of the Port of New York Authority.

At the meeting of this club on Thursday evening, February 2nd, "Recent Developments in Concrete," illustrated by lantern slides, was given by Col. H. C. Boyden, engineer for the Portland Cement Association, and important discoveries as to "Water Content" and "Setting" were discussed.

ENGINEERS' ASSOCIATION OF FAIRFIELD COUNTY

The regular meeting, at Stamford, February 2, was addressed by Frank W. Skinner, associate editor, PUBLIC WORKS, on "Tunnelling," illustrated by numerous stereopticon slides.

Among the important tunnels described were the Simplon line, the underground tubes in London and Paris, and various types of tunnels in New York, where the operations of driving through quicksand, boulders, and partly through rock and silt, involve unusual difficulties that have been met with great skill and ingenuity as in the case of short steel tube tunnels towed a long distance and sunk to bearing on pile foundations; a Harlem River tunnel built in an airtight lined dredged trench, covered by a massive timber platform; the quadruple track steel lined tunnel with its tubes built on shore, launched, floated to position, sunk under pneumatic control in successive sections and eventually enclosed in a monolithic mass of concrete deposited under water by multiple tubes, and the shield driven Pennsylvania Railroad, Rapid Transit tunnels and Hudson Tubes.

Some of the notable tunnel accidents,

due to flooding, poisonous gas and fire were described, together with the means for preventing them, and a resume was given of various ingenious methods devised for tunnel construction under the most difficult conditions, including the centre or pilot tube for a Brooklyn sewer tunnel, and the sectional roof lining, both for quicksand operations, the freezing process and the caisson process for subaqeous tunnels, the improved trench methods advocated for the Narrows tunnel and the North River tunnels, New York, the half shield, the caisson and the floating anchored type with examples of different constructions involving brick, concrete, steel, wood, cast iron and concrete linings.

The address was one of a series that includes long and lofty bridges; municipal waterworks, highways and pavements, and other important types of necessary construction work that are emphasized because of the high returns that they yield directly, and the development, prosperity and quick relief that their construction affords both for unemployment and for the present prolonged stagnation of business and construction. These features make the design and construction of such public works a great public benefit and afford engineers, contractors and officials an opportunity for perform ing services of the highest value to the commonwealth that at the same time compensate and distinguish their authors.

ANNUAL MEETING OF NEW JERSEY MUNICIPAL LEAGUE

The annual meeting of the New Jersey League of Municipalities met at Trenton on January 30 and discussed the State's blue laws, and the exemption of new dwellings from taxation. The session was addressed by Dr. Copeland, health commissioner of New York City, who spoke of the pollution of New Jersey beaches, which address resulted in the adoption of resolutions protesting to the Federal authorities against the pollution contributed by the dumping of garbage by New York City and the discharge of oil wastes, sewage and factory refuse along the seacoast.

Commissioner Gillen stated that the problems in connection with public utility legislation were becoming so serious that their possible ultimate solution can be found only in public ownership.

The league elected the following offers: President, Commissoner Charles P. Gillen, of Newark; Vice Presidents, Mayor Clarence E. F. Hetrick, of Asbury Park; Commissioner James F. Gannon, of Jersey City, and Mayor Edward L. Bader, of Atlantic City; with Clinton J. Swartz, of Trenton, as secretary-treasurer.

On January 28th Major Charles H. Miller of Little Rock, at one time a director of the A. S. C. E., was elected president of the Arkansas chapter of the A. A. E.; and Major E. A. Kingsley was re-elected secretary.

KANSAS ENGINEERING SOCIETY

The fourteenth Annual Meeting of the Kansas Engineering Society was held at Hutchinson, Kansas, on December 22nd and 23rd, 1921. This meeting was one of the most interesting, as well as the most beneficial meetings the organization has ever held. Considerable progress was made during the past year and the Society went on record at this meeting as being in favor of all progressive legislation questions that may arise.

Particular interest is felt in the legislation for the patent office as prescribed in the Lampert Bill, H. R. 7077, which seeks to effectively remedy the existing condition of the Patent Office at Washington. It is hoped that other organizations interested in matters pertaining to the proper development of this Department will take such action as is necessary to bring it properly before their Senators and Representatives, that favorable action may be had by Congress.

The newly elected officers are: Lloyd B. Smith, president; P. L. Brockway, vice president; J. M. Averill, secretary-treasurer; P. J. Ruckel and H. B. Walker, directors.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

At the annual meeting of the American Society of Agricultural Engineers held in Chicago December 27th-29th, the following subjects were discussed: flood control, drainage and irrigation in relation to agriculture, and farm buildings, their construction, sanitation and drainage. Prominent among the papers was one on "Flood Control in Agriculture," by Arthur E. Morgan. The following officers were elected for 1922: president, A. J. R. Curtis; vice-presidents, G. W. McCuen and David Weeks; and secretary, Raymond Olney.

ENGINEERING INSTITUTE OF CANADA

At the annual meeting of the Engineering Institute of Canada held at the Montreal headquarters of the society on January 24-25 three new chapters of the society were established, technical discussions were presented, and officers for the coming year elected. These are: President, J. G. Sullivan, and vice-presidents, Brig. Gen. C. B. Mitchell and Arthur Surveyor. The three new branches of the society are at Sydney, Nova Scotia, London, Ont., and Lethbridge, Alberta. The social features of the meeting included a visit to the Dominion Engineering Works at Rockfield, the annual banquet and a smoking concert.

DETROIT ENGINEERING SOCIETY

The feature of the February 3rd meeting of the Detroit Engineering Society was an illustrated address by Clifford M. Holland, chief engineer of the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission, on "The Hudson River Vehicular Tunnel Its Construction and Ventilation."

The Engineers' Society of Western Pennsylvania has moved from 568 Union Arcade Bldg. to the William Penn Hotel, Pittsburgh.

PERSONALS

Fauntleroy, Capt. J. D., for the past five years federal district highway engineer in Texas of the Bureau of Public Roads, was appointed state highway engineer at a salary of $9,000, to fill the vacancy caused by the recent resignation of Rollin J. Windrow.

Hubbell, Clarence W., city engineer of Detroit, Mich., has tendered his resignation to Joseph A. Martin, commissioner of public works, to become effective March 1.

Miller, Frank, has been appointed commissioner of water for Toledo, O., to take the place of George N. Schoonmaker, who has been at the head of the water department since September 20, 1920.

Piper, Oscar A., who has been connected with the Seattle city engineer's department since 1908, has been appointed superintendent of streets and sewers for that city.

Kluegel, Harry A., until recently construction engineer in the Quartermaster Corps, U. S. A., has been named chief of the division of water rights for the State of California.

Costello, James, has been appointed division superintendent in the county road department, Allegheny County, Pa.

Husted, A. G., has become assistant sanitary engineer of the sanitary engineering district of Cuyahoga County, Ohio.

Goodrich, Clinton R., has been made commissioner of public works of Utica, N. Y.

Hanson, Conrad, has been appointed highway commissioner for Douglas County, Wisc.

Doucet, A. E., director of public works, Montreal, Quebec, has resigned, effective Feb. 1.

McDougald, W. L., of Montreal, has been appointed chairman of the harbor commission of Montreal.

Coyne, Thomas, has been reappointed superintendent of streets of Marlboro, Mass.

Thomas, O. P., of Johnstown, Pa., has been elected borough engineer of Conemaugh, Pa.

Colony, J. I., has been elected borough engineer of Renovo, Pa.

LEWIS S. SADLER

Lewis S. Sadler, Pennsylvania State Commissioner, died at his home in Carlisle, Pa., January 20. He was forty-eight years old, and had been ill a week.

Mr. Sadler was prominently mentioned in the recent discussion of candidates to succeed the late Senator Boies Penrose, and for nomination next fall to succeed Governor Sproul.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

MAXON CONCRETE ROAD FINISHER

This machine, built by the Maxon Company, is provided with a 9-horse power gasoline engine and has two demountable rear wheels to transfer it from place to place. It has no cast iron, all castings are the finest grade of semi-steel, malleable iron or cast steel and all gears are cut. Among the valuable features reported are the divided strike-offs that insure perfectly balanced motion and minimum reaction on the forms; a pneumatic tamper with adjustable scoop and crusher; slow moving, long stroke adjustable belt float; completely enclosed transmissions; all metal, durable strike-off and tamper; independence of the different operations; absence of vibration; and central position of operator. The tamper extends across the full width of the road and is operated by compressed air.

BATES' CRAWLER DRIVE FOR FORDSON TRACTOR

The latest development of the Bates' Machine & Tractor Co. is a steel crawler drive for the Fordson Tractor. It is the same general construction as the crawlers on the Bates Steel Mule. It can be put on in the field in about an hour's time as it is not necessary to drill a single hole or alter the tractor in any way. The drawbar pull of the Fordson is greatly increased on soft ground or sandy soil due to the grip of the crawler traction. Dynamometer tests show an increase in drawbar horse-power on soft ground ranging from 25 to 60 per cent.

The sprockets are of alloy steel with openings between the teeth which permit the dirt to fall through, and is a patented construction of the Bates' Steel Mule.

TURNING IN MINIMUM CIRCUMFERENCE

These sprockets are mounted directly on the rear axle shaft. The front idler crawler wheels are the same as the Bates' Steel Mule and are carried on Hyatt Roller Bearings, entirely inclosed from the dust. The tension of the crawlers is taken up by coil springs which are adjustable. To get the same pressure on the front end of the crawlers as on the rear, a semi elliptical spring is attached to the front of the crawler frames and the under part of the tractor. This spring is pivoted in the center which permits the crawlers to oscillate entirely independently of each other and at the same time get an equal pressure at all points.

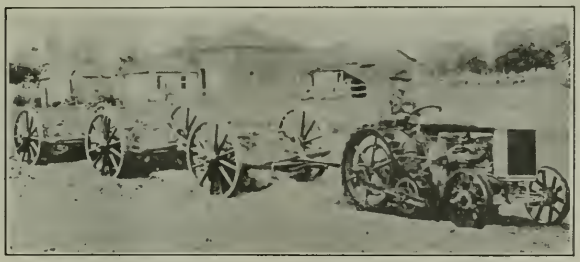
The tractor is fitted with two crawler turning devices, each having an independent foot lever so that either crawler can be slowed down or stopped entirely for short turning, with the result that an inside turning circle of 2 feet is obtained. The 8-inch wide crawler shoes are so made that rubber blocks can be attached on to the crawler at a slight additional cost for hauling over pavements or any highway that might otherwise be injured by metal cleats. These rubber clad crawler's shoes are also used for hauling in and around industrial plants. The manufacturers have announced the price of $295.00.

AUSTIN DRUM MIXERS AND PAVERS

The Austin Machinery Corporation have just placed on the market a complete line of popular-priced drum mixers.

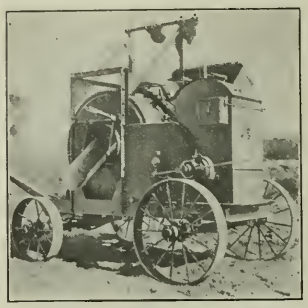
Heretofore the Austin mixers have been of the cube design the mixing being acomplished without the aid of blades or paddles, simply by throwing the batch from plane to plane with a force varying according to the speed of revolution. This necessitated materials and construction of unusual strength, which naturally would reflect in the price asked.

In the new drum type mixer, recourse



BATES CRAWLER HAULING THREE WHEEL SCRAPERS ON ROAD GRADING JOB

is had to the customary elevating mechanism of the interior. The consequent freedom from unusual strain saves on construction cost and meets the demand for a moderately-priced mixer, equal to every ordinary requisite in the way of volume, rate and quality of output, working life, low maintenance cost, and manageability.



AUSTIN PORTABLE CONCRETE MIXER

The same principle has been utilized to produce a secondary line of Austin pavers. The mixers will be supplied in all standard sizes from one-half bag to two yards, and the Pavers in sizes from one-half yard to two yards.

INDUSTRIAL NOTES

Bucyrus Co., South Milwaukee, Wis., with Northwestern sales office at 608 Pittock Block, Portland, Ore., announces the appointment of A. R. Hance as Northwestern sales manager, succeeding L. T. Russell, who has resigned after ten years of service with the company.

The Triest Contracting Corporation, W. G. Triest, president, 126 E. 59th Street, New York City. The corporate name of Associated Contractors, Incorporated, has been changed to Triest Contracting Corporation. Mr. O. A. Mechlin, formerly Commander C. E. C., U. S. Navy, R. F., has joined as vice-president.

An agreement has recently been reached between the East Jersey Pipe Company and the Riter-Conley Company whereby "Lock Bar" Steel Pipe, which has been exclusively controlled by the East Jersey Pipe Company since its introduction into this country in 1905 and has been hitherto manufactured by the East Jersey Pipe Company at its plant at Paterson, N. J., will be hereafter fabricated in the Pittsburgh district by the Riter-Conley Company at its Leetsdale plant. This is regarded as a step forward by both parties, as it will permit considerable saving in freight rates and economy in manufacturing. The sale of "Lock Bar" Steel Pipe will continue to be exclusively in the hands of the East Jersey Pipe Company.

The Dayton-Dowd Co., Quincy, Ill., announces the opening of a district office in Pittsburgh at 809 Keenan Building, covering the sale of their Centrifugal Pumps and Underwriters' Fire Pumps. The office will be in charge of Mr. T. J. Barry, who for the past several years has been connected with the home office on engineering and sales.

At the Chicago Good Roads Show the Pawling & Harnischfeger Company distributed a novel souvenir which consisted of two concentric cardboard discs, pivoted together by an eyelet in the center. The idea back of this novelty was to show why the P. & H. Excavator Crane was an eight-in-one machine. By revolving the upper disc the various booms that may be used with P. & H. appear successively—the standard boom with dragline bucket, boom with garb bucket, boom with material handling hook, boom with Magnet, boom with backfilling scraper, shovel attachment, skimmer scoop and pile driving rig.

The City of Indianapolis has just ordered a sample garbage cooker like those that are now in use in Dayton, Ohio, and which are claimed to be odorless. If the new cooker proves satisfactory it is expected that Indianapolis will purchase 11 more.

COST OF TRACTOR SERVICE FOR ROAD GRADING

Tractors manufactured by Case Threshing Machine Co. were satisfactorily used on road grading contracts by W. A. Kettlewell, Iowa City, Iowa, who writes that in very light sand the tractor loaded a Maney wheeler with a 75 foot snap cable. It was necessary to carry the 11,000-yard cut to grade as the work progressed and the wheeler was pulled up out of a sand pit about 12 feet in depth.

The tractors "both proved themselves to be very satisfactory on our work. The machines both stood up exceptionally well and your service has been all that we could ask. While the machines always had the best possible care, both were put through the hardest kind of tractor service. At the end of the season only a few minor repairs were required to have them back in strictly first class condition. * * * The 22-40 H.P. tractor has ample power to deliver the goods in anything we encountered and is still light enough to handle easily in very difficult places."

Operating Costs—Case 15-27 Tractor

Basis — Case 15-27 H. P. Tractor in use on highway grading for loading Maney Four-Wheeled Scrapers of one cubic yard capacity during the year of 1919.

76 2-3 nine-hour working days.

122 calendar days.

Yardage moved approximately, 29,000 cubic yards.

Item	Cost per Working Day
Labor Operating	$6.85
Repairs	2.14
Accessories, small tools, etc.	.29
Fuel and oil	3.89
Depreciation, annual	6.52
Interest	1.00
Total cost per working day	$20.69

The tractor was in perfect condition at the end of this period.

Operating Costs—Case 22-40 Tractor

Basis — 1 Case 22-40 H. P. Tractor working on highway grading to load Maney Four-Wheeled Scrapers of one cubic yard capacity.

125.5 nine-hour working days between April 10 and October 10, 1920.

Yardage moved approximately, 41,000 cubic yards, which material included a large percentage of fine sand or heavy mud.

Item	Gallons Used per Working Day	Cost per Working Day
Labor operating	....	7.771
Repairs	....	1.29
Cylinder oil	2.87	1.833
Kerosene	24.3	4.877
Hard oil	30 lbs	.041
Gasoline	7.18	2.00
Transmission oil	.661	.483
Interest, annual	....	1.50
Depreciation, annual	....	7.00
Storage, annual	....	....
Taxes & Insur.	....	....
Total	....	$26.80

Average prices of fuel and supplies as follows:

Kerosene	$0.20	per gal.
Gasoline	.276	per gal.
Hard oil	.17	per lb.
Cylinder oil	.64	per gal.
Transmission oil	.73	per gal.
Labor operator	139.33	per month

The item of repairs includes daily field repairs and general shop repairs.

TRACTORS HAULING ROAD MACHINES IN HEAVY WORK

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 FEBRUARY 18, 1922 No. 7

Paving by City Forces

By H. J. Hammer, City Engineer

A reinforced concrete surface laid on an old concrete base at a cost fourteen per cent less than the lowest bid.

During the late summer of 1921 a portion of West Fulton St., Gloversville, N. Y., was repaved with reinforced concrete approximately 5½ inches in thickness. This portion of the street had been paved with cedar block on sand foundation in the year 1890 at a cost of $1.03 per square yard and repaved in 1901 with Park vitrified brick on 6-inch concrete foundation at a cost of $1.985 per square yard.

This portion of West Fulton St., which lies just west of the railroad crossing of the Fonda, Johnstown and Gloversville Railroad Co., is subject to very heavy traffic, being the only outlet to the west from the freight house.

On April 19th, 1921, bids were received upon this work with the intention of removing the old brick surface and sand cushion and placing on top of the old concrete base a 5½-inch surface of concrete, reinforced with steel weighing 32 lbs. per 100 square feet.

After the bids had been tabulated, however, it was deemed for the best interest of the city that all bids should be rejected and the work done by city labor

BRICK PAVEMENT IN GLOVERSVILLE, N. Y., AFTER CARRYING HEAVY FREIGHT STATION TRAFFIC FOR TWENTY YEARS

Comparison Between Lowest Bid and Cost by City Forces

		Quantities used	Unit price bid by contractor	Unit price by city	Contractor's total	City's total
1.	Removing old brick and sand cushion	2,235.55 sq. yds.	0.25	0.227	$558.89	$496.60
2.	Portland cement	610.00 bbls.	3.50	2.97	2,135.00	1,812.86
3.	First class concrete for pavement	344.52 cu. yds.	7.90	6.59	2,721.71	2,271.00
4.	Metal reinforcement furnished and placed	22,160.00 sq. ft.	0.0175	0.0159	387.80	353.40
5.	Setting and resetting curb in concrete	52.00 lin. ft.	0.65	1.14	33.80	59.37
6.	Furnishing new concrete curb	3.20 lin. ft.	0.45	0.37	1.44	1.20
7.	Furnishing new circular granite curb	48.80 lin. ft.	3.00	3.00	146.40	146.40
8.	Furnishing new concrete driveway turns	2 each	1.25	1.00	2.50	2.00
9.	Setting stone headers (furnished by city)	24.80 lin. ft.	0.65	0.474	16.12	11.75
10.	Furnishing and placing extra concrete (including cement)	14.28 cu. yds.	14.50	12.02	207.06	171.65
					$6,210.72	$5,326.23

under the direction of the city engineer. On the 8th day of September the first bricks were removed from the old pavement and on the 16th day of September the last of the concrete was placed in the pavement.

The above table shows a comparison of prices bid by the lowest bidder as against the actual costs of the different items of work as done by the city, and also the total cost of the work done by the city compared with what the total cost would have been had the work been done by the lowest bidder:

From the above table it will be noted that the total cost of the work as done by the city was $5,326.23, and the total cost of the work, if the contract had been awarded, would have been $6,210.72. This shows a saving of $884.49 or 14.2 per cent.

Treating Wood Block with Asphaltic Road Oil

By A. D. Stivers*

The city of Fort Worth, Texas, in common with other cities in the country, has had trouble with old wood block pavements. Main street, from Weatherford street to East Front street, was paved with creosoted wood block in 1916; and Houston street, from Weatherford street to East Front street was paved with the same material in 1913. These streets are in the main retail business streets of the city and carry a heavy, dense traffic. Each is 4,400 feet long and 56 feet wide between curbs, with a double-track street car line.

For the past two or three years these streets have given a great deal of trouble due to the expansion of the blocks from the absorption of water. This trouble, of course, has been confined to wet weather and has been so serious, on Houston street in particular, that the street has been almost impassable after a long period of rainy weather. Hummocks have formed several yards in diameter and 12 inches in height, which in some instances blew up and in others were broken through by passing traffic, so that some of the blocks would be destroyed or washed away.

In August, 1921, D. L. Lewis, city engineer of Fort Worth, taking advantage of the fact that practically no rain had fallen for two months and the blocks were thoroughly dry, repaired all bad places in the streets and treated the surfaces with asphaltic road oil. New blocks were used to repair places where the old blocks were crushed, and portions were relaid where the pavement surface was rough due to repeated expansions and contractions.

*Engineer, Asphalt Sales Department, The Texas Company.

An expansion joint 1 1/2 inches wide was constructed along each curb and extended on a line with the face of the curb across intersecting streets. This joint was formed by cutting out portions of the old blocks and was filled with 50 per cent. of Texaco No. 39 Paving Filler and 50 per cent. coarse sand As soon as the general repairs and expansion joints had been completed the street was swept clean and treated with Texaco Special Macadam Binder, containing 75 per cent. of asphalt, at the rate of 0.2 gallon per square yard of surface. This material was applied with a Good Roads pressure distributor at a temperature of about 220 degrees F. The surface was then immediately covered with coarse sand, one cubic yard being used to cover 120 square yards, and traffic immediately turned over the street.

All work was done between midnight and 6:00 a. m., one-half of the street being treated at a time so as to cause as little inconvenience as possible to traffic. The treatment of both streets was completed in three nights, only three hours being required on the third night to complete the job. There was practically no interruption of traffic during the whole operation. Both repairs and treatment of surface were done by J. F. Wills, general contractor, of Fort Worth.

The space between the tracks of the street railway company was treated by them in a somewhat similar manner, the asphalt being poured by hand and covered with fine limestone chips instead of with sand. At the present time that portion of the surface covered with sand has a better appearance than that covered with limestone chips. This is due in part to the fact that there is much less traffic between the rails to iron out the surface.

Up to the time that this article is written, four months after the completion of the work, the treatment has been a complete success. There have been several rains during this period, but the blocks have shown no tendency to swell or buckle. The treatment seems to adhere perfectly to the blocks, and to seal them so that no water is absorbed or permitted to filter down between the blocks into the sand cushion. The surface has somewhat the appearance of a sheet asphalt pavement.

CREOSOTED WOOD BLOCK PAVEMENT, MAIN STREET, FORT WORTH, TEXAS
Treated with Texaco asphalt macadam binder

Rolled Bases for Brick Pavements

By Stanley A. Knisely*

Return to this type of base, but built with more intelligent purpose than twenty-five years ago, encouraged by investigations and reports of Federal Bureaus and others.

Increased interest in and use of the rolled base for brick pavements is due principally to three causes; first, the continued good behavior of this type as year after year brings added age and heavier traffic burdens without their failing, as had been predicted by some; second, to new knowledge of the action of capillarity as expressed in part by the recent report of the sub-grade committee of the late Federal Highway Council; and third, to the recent survey of this type conducted by the engineering staff of the United States Bureau of Public Roads with its subsequent favorable report.

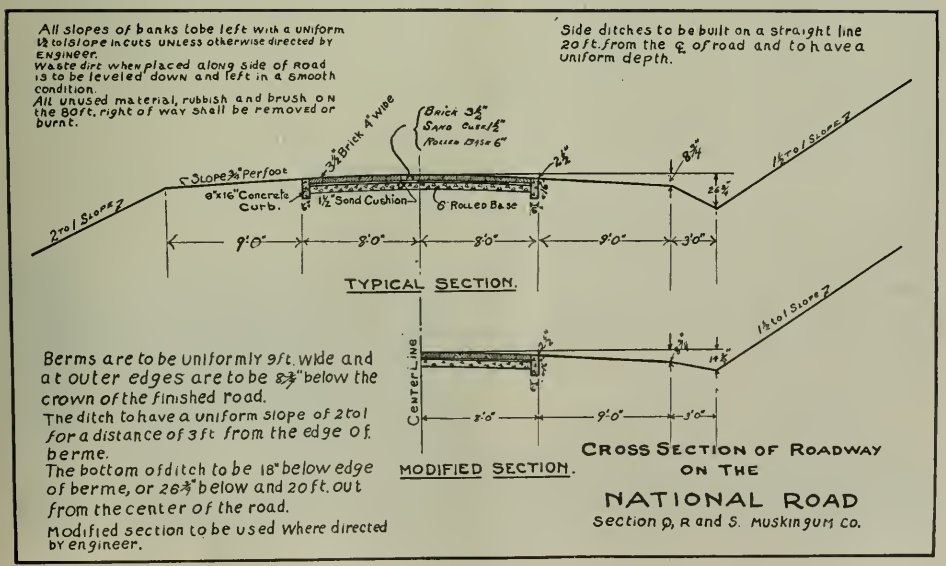
Rolled gravel, slag or crushed stone, spread in one or more courses, thoroughly compacted and bound with screenings, describes the rolled base in question. Its thickness is determined by the nature of the traffic it will be required to accommodate. Not more than 6 inches, with one inch of cushion, is customary on medium-traffic roads. Eight inches with an inch of cushion has been used successfully on the heaviest-traffic trunk lines.

In localities where gravel, slag or crushed stone is readily available there are instances where the rolled base has given satisfactory service under brick surfaces for as long as 25 years. The availability and low cost of the material probably figured largely in the choice of this base material in its earlier uses. Today, however, with highway engineers paying more and more attention to drainage and studying the action of capillarity as it affects various pavement types, the rolled base is adopted out of other and more important considerations than low cost.

As to the behavior of rolled bases under brick surfaces, the survey of the Bureau of Public Roads (conducted in Ohio because within the limits of that state were to be found the diverse soil, drainage and traffic conditions common to most parts of the country) covered rolled bases which had served up to ten years. This report, in its conclusions, finds the rolled base very satisfactory, and these conclusions are identical with those reached by highway engineers in many counties throughout Ohio and neighboring states who have been using the rolled base. As stated in the beginning of this article, the behavior of the rolled base, particularly on roads which never were designed to support the exceedingly heavy traffic which they are forced to accommodate today, is one of the arguments in its favor.

In the consideration of the action of capillarity, the report of Messrs. Charles M. Upham, A. T. Goldbeck, W. P. Blair and H. G. Shirely, who compose a special committee on sub-grade to continue

*Economist, National Paving Brick Manufacturers' Association.


All slopes of banks to be left with a uniform 1½ to 1 slope in cuts unless otherwise directed by Engineer.
Waste dirt when placed along side of road is to be leveled down and left in a smooth condition.
All unused material, rubbish and brush on the R.O.W. right of way shall be removed or burnt.
Side ditches to be built on a straight line 20 ft. from the ℄ of road and to have a uniform depth.
Brick 3½"
Sand Cush. 1½"
Rolled Base 6"
3½" Brick 4" wide
Slope ⅜" per foot
8"x16" Concrete Curb.
1½" Sand Cushion
6" Rolled Base
2½"
8¾"
24¾"
2 to 1 Slope
1½ to 1 Slope
9'0"
8'0"
8'0"
9'0"
3'0"
TYPICAL SECTION.
Berms are to be uniformly 9 ft. wide and at outer edges are to be 8¾" below the crown of the finished road.
The ditch to have a uniform slope of 2 to 1 for a distance of 3 ft. from the edge of berme.
The bottom of ditch to be 18" below edge of berme, or 26¾" below and 20 ft. out from the center of the road.
Modified section to be used where directed by engineer.
Center Line
MODIFIED SECTION.
CROSS SECTION OF ROADWAY ON THE
NATIONAL ROAD
Section O, R and S. Muskingum Co.

CROSS-SECTION OF NATIONAL ROAD, SHOWING A BRICK PAVEMENT LAID ON A SIX-INCH ROLLED BASE

this phase of work started by the Federal Highway Council, contains this definite conclusion:

SOME HIGHWAY ENGINEERS' OPINIONS

"The committee wishes to call attention to the fact that interposing a layer of coarse material between the sub-grade and the surface will greatly retard the water or moisture from passing through or above such layer by capillary action, and it is the opinion of your committee that over all clays and adobe soils a layer of some kind of coarse material such as gravel, cinders, rotten rock, slag or stone should be used where the cost would not be unreasonably excessive."

F. H. Eno, Director of Research of the Ohio Good Roads Federation, in the federation's First Annual Report on Survey of Road Failures, just off the press, has this to say:

"Until research has revealed a more economical and satisfactory method of treatment, the following is recommended for trial. It is suggested as the result of some successful work done by the writer in paving a street over a swamp in Winnetka, Illinois in 1896. Excavate the sub-grade of the road, over all places where dense clay is encountered, 4 to 6 inches deeper than called for in the specified foundation. Fill this extra depth of sub-grade with clean gravel or graded broken stone. Be careful to bind the top portion of the porous course with sand or a clean binder that will permit the flow of water, but will not allow the concrete mortar (in this case a concrete base was used) to settle into the material and interfere with the drainage."

In brief, highway engineers who favor the rolled base for brick pavements, do so in the belief that the coarse material will at least greatly retard capillary action, keep the moisture level lower down in the sub-grade, keep the sub-grade more stable, cut down to a minimum the forces of expansion due to freezing and saturation of the base immediately under the surface, and finally provide a permanently substantial, yet flexible, support for the surface.

At the same time, the modern practice in the case of brick surfaces on rolled bases, is to use asphalt filler. The base, being flexible, calls for a flexible surface that will come and go with the forces of expansion and contraction, without cracking and upheaving.

POLICY OF BUREAU OF PUBLIC ROADS

This report of the Bureau of Public Roads may presumably be regarded in the nature of a statement of future policy. Up until this survey of rolled bases, the bureau had endorsed the rigid base. Therefore, the conclusion reached by the engineers of the bureau in their report on the survey are of more than ordinary interest. These conclusions follow in respect to those roads in which the Federal Government is interested.

"In summing up, a study of these roads would seem to warrant the following conclusions:

"That the rolled-base type, provided it is properly placed and compacted, is a suitable type for brick construction where soil conditions are favorable and good natural drainage may be obtained. Under these conditions a 6-inch compacted rolled base should be adequate, provided a 2-inch sand or screenings cushion is used.

"That the rolled base may be successfully used under ordinary road conditions, provided the thickness of the base is adjusted to meet the probable traffic requirements. An 8-inch to 10-inch compacted base, with an additional 2 inches of cushion should suffice under all but trunkline highways subjected to very heavy traffic.

"That whenever a rolled base is used, a bituminous rather than a grout filler should be employed in order to provide a flexible section throughout.

"That, in general, asphalt fillers are more satisfactory than tar or tar mastic fillers, owing to the tendency of the latter either to chip out or flow in hot weather, leaving the edges of the brick unprotected.

"That very inferior material, as measured by laboratory tests, may be successfully used as base material for brick roads."

FOR CITY STREETS

Use of the rolled base for city streets as well as rural highways is increasing. A stretch of the Lincoln Highway through the Borough of Wilkinsburg, Pennsylvania, was paved with brick on a rolled slag base last summer. Three-inch brick were laid flat and asphalt filler was used. The city of Warren, Ohio, has adopted the rolled slag base almost exclusively for city streets. Albert C. Smith, C. E. of the Smith Engineering & Construction Company of Warren, in writing recently about Warren's paving policy, says:

"We favor the rolled slag base because if thoroughly compacted it makes just as durable, firm and substantial a base as I know of; is elastic under climatic changes; is cheaper than some; furnishes a means of drainage in addition to the drainage behind the curbs and thus retards capillary action, and permits extending the paving season into cooler weather because there is no danger from freezing."

As to asphalt filler, the same writer says:

"We favor using asphalt filler because it stays where it is put without running into the gutters or being carried away on the automobile tires, allows for sufficient expansion and contraction in the surface, adheres well to the joints of the brick and keeps out water, is obtainable today in a better grade than in the past, and assists in providing a quiet pavement."

The rolled base is not a new idea by far. Engineers used it a quarter of a century ago. Significance, however, centers around the fact that highway research is revealing reasons for the rolled base which are directing renewed attention to it. Not a few engineers who once used it and then abandoned it, not because it failed but because they thought something better was offered, are returning to this base material.

The Bureau of Public Roads report, therefore, formally introduces the rolled base type into the family of paving brick types and gives it a definite place among them. The field of design is not narrowed by any reflection on other types of bases, but is widened by the formal recognition of and increased interest in an old type.

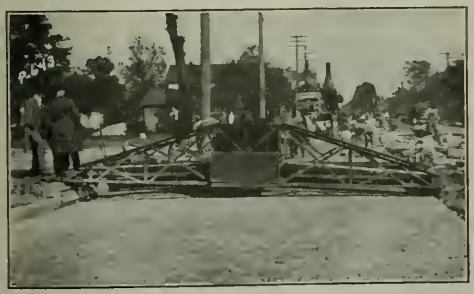
Paving Euclid Avenue

Six miles of brick pavement on concrete base with stone curbs. Smooth surface secured by finishing machine with counterbalance tamper running on special track.

Euclid Avenue, in Euclid, Ohio, is paved for 3 miles with an 18-foot strip of brick pavement on each side of the center of the street (two parallel strips 20 feet apart), which is to be double tracked, thus making 6 miles of 18-foot pavement, which is being executed at a contract price of $460,000 by the Freshwater Construction Co., Cleveland, and by Baldwin Bros., in equal parts. The brick surface has a concrete base from 4 to 12 inches thick, reinforced with ¼-inch wire mesh and with two ½-inch bars at the edges. The alignment is nearly straight and level and the road is drained by one line of 4-inch tiles under the curbing on each side, and two lines of tiles in the center. The outer edge of each strip of brick pavement has a convex stone curb extending 6 inches below the grade of the inside form.

Part of the broken stone for the concrete base was produced by a local quarry and stored only on subgrade. The remainder of the stone and the sand were delivered at a point about one-half mile from the center of the job where cement also was unloaded from cars on an adjacent siding. Both cement and aggregate were delivered by Mack and White trucks to the 21-E Foote mixer, that was served by a Koehring loader, and supplied with water from the city service. Sometimes as many as 15 trucks were occupied in delivering cement and aggregate. The brick was delivered by five flat top Packard trucks hauling it almost continuously as fast as space could be cleared for the bricks to be piled. Difficulty was experienced in delivering materials on the south side of the street on account of the necessity of dumping them over the suburban car tracks.

At first there was trouble in securing a smooth surface of the brick pavement, but as the stone curb did not offer satisfactory support, it was impossible to use a finishing machine until the contractor's engineer devised for it a special track on top of the curb and also designed a special counter weighted tamper, both of which were entirely satisfactory from the outset.



FINISHING MACHINE WITH COUNTERWEIGHTED TAMPER

The use of the finishing machine enabled the contractor to dispense with considerable labor of the pick-up. Although the presence of the machine in the rear of the brick droppers had a stimulating effect upon them, the best effort did not enable them to keep up with the full capacity of the machine although an average progress of about 500 feet per day was achieved. The brick droppers were always kept within 40 feet of the concrete mixer, which at no time was pushed to its capacity.

CURB TRACK FOR TAMPING MACHINE

Preliminary work was commenced in June last and construction was suspended on November 1st after the completion of about 4 miles of pavement, leaving 2 miles that will be finished in the spring.

The excavating, grading, paving, concreting, grouting and installation of drains required an average force of about 60 men for each contractor. Just before the work was suspended last fall the Freshwater Construction Co. laid 3,750 linear feet of 18-foot pavement with 6-inch concrete subbase and a 12 x 22-inch trench on each side in nine days of nine hours each.

Notes on "Cost of Local Materials"

The following items are supplementary to the table on page 128.

Ft. Lauderdale, Fla., reports the cost of cement as $4 net per bbl.

Ft. Myers, Fla., reports the cost of "dead oyster shells" as $1.50 per cu. yd.

In Ash'and, Ky., crushed slag cost $3.75 per cu. yd.; in Lackawanna, N. Y., $1.25 per cu. yd.; in Alliance, O., $2.70 per ton; in Cleveland, O., $3 per cu. yd.; in Lakewood O., $2.70 per ton; in Oberlin, O., $2.40 per ton; in Duquesne, Pa., $1.15 to $1.25 per ton on siding; in Oil City, Pa., $2.80 per cu. yd.; Fairmont, W. Va., $3.50 per ton.

In Du Bois Pa., crushed sandstone costs $2.25 per ton and crushed limestone $3.50.

In Pawtucket, R. I., local stone cost $2.75 per ton, but trap rock on street $3.65 per ton.

Economical Delay

It is reported that the contractors in Toledo saved the city $250,000 by a determined stand against extortion by the brick dealers and the bricklayers. The school board delayed their program until the contractors were ready to bid, and prices and wages became reasonable, and nobody suffered from injustice.

Pittsburg Test Highway*

By Charles W. Geiger

TEMPERATURE VARIATION IN THE SLAB

A series of holes were drilled in the various sections approximately 5/8 inch in diameter and filled to a depth of 1/2 to 3/4 inch with mercury for taking temperature of the slab (See description in issue of Dec. 10). The following table shows the typical situation for one day.

		Slab F, 5-6		Slab F, 6-7		Slab D, 6		Slab C, 1-2	
Time	Atmosphere	Bot.	Top	Bot.	Top	Bot. Center	Top	Bot.	Top
8:05 a.m.	60°	55	52	58	53½	55 54	53½	56½	56
10:00 a.m.	65½°	56	60	59½	62	58 59½	62	59½	65
11:30 a.m.	73½°	58	68½	62	70	61¼ 65½	70	63½	73
1:00 p.m.	76°	61	73	64½	75	65½ 70	75	68	78½
2:45 p.m.	78°	64½	74	68½	76	68½ 72	75	70½	77½
4:35 p.m.	74½°	66½	69	69	71	69½ 70	70	70½	71

EXTENSOMETER MEASUREMENTS OF STRAIN

An extensometer reading to 1/60,000 inch was specially constructed for use in these tests. (See p. 449, issue of December 10.) The following points brought out in these tests are of interest:

1. With extensometer placed in the center between the two rear wheels and in direction of the rear axle a movement in Slab B of 13 divisions (corresponding stress with E assumed 2,000,000 is 41 lbs. per sq. in.) of tension was noted.

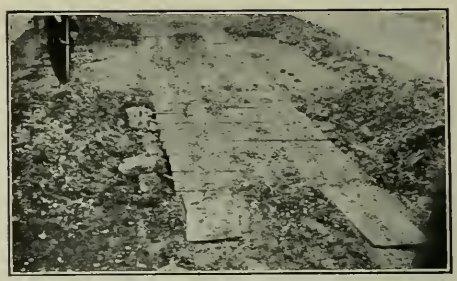
2. With extensometer back of rear wheel as close as possible, the strain was 5 divisions of compression.

3. A line of points for extensometer measurements was set on a diagonal at a corner formed by the intersection of a construction joint with the edge of the slab. A rod was driven in order to measure vertical deflection with the Ames dial. In the late afternoon after a day of traffic, a truck was backed on to this section so that one rear wheel was at the corner, the other also on the slab the gauge length away. The extensometer and Ames dials were set and the truck moved off. This was repeated, getting readings between successive extensometer points. On the following morning the whole experiment was repeated. The following tells the story:

Point	Vert. Defl.	Strain Divisions	Time
1-2	...	22	5:15 p.m.
2-3	.028	12	.....
3-4	.028	9	.....
4-5	.027	11	.....?
5-6	.027	5	.....
1-2	...	.31	7:30 a.m.
2-3	.067	.29	"
3-4	.068	.23	"
4-5	.066	.25	"
5-6	.066	.25	"

It will be noted that the vertical deflection in the morning was much greater than in the afternoon experiment. Also that the extensometer readings were greater and the cantilever action extended further along the diagonal line. The zone of support had apparently moved from a point approximately two feet from the corner to at least five feet. This was probably caused largely by the curl of the pavement due to temperature. Another interesting test, as the truck moved off of the slab under test on to the adjacent slab, but 10 per cent of the total deflection was lost. As the load was taken farther away the deflection decreased till at a distance of

*Concluded from page 104



REPAIRING BREAK IN SECTION B WITH 12 BY 12 TIMBERS

ten feet its effect was lost. In the morning measurement 90 per cent (approximately) of the deflection was lost in moving the wheel load just over the joint and on to the adjacent slab. The two slabs were separated by a one-half inch wooden header board. The relative atmospheric temperature was 65 degrees for the first test and 45 degrees for the second.

LABORATORY TESTS ON THE SUBGRADE

Moisture content determinations have been run under all sections of the pavement from the period before the concrete was laid up to date.

At the request of the engineers representing the California Automobile Association, points were set spanning construction joints both transverse and longitudinal, as well as transverse cracks which opened after the pavement was poured. Holes were drilled in the pavement to a depth of approximately one inch; these filled with lead and marks for measurement scratched thereon. Readings were taken by means of a scale reading to 1/64 of an inch.

The first rainfall after the traffic tests were started occurred on November 21. By the following morning .42 inches of rain had fallen. Truck traffic was continued until noon of this day. It was very noticeable that the deflections of the pavement at the corners was less than on the previous day. This observation was checked by comparing the automatic graphs for November 22 against those of November 21, whereby it was found that there was approximately 60 per cent of that on November 21 for the same load. This is apparently due to the fact that the grade under the shoulder swelled with the first application of water and effected a better subgrade reaction in this zone.

REPAIRING BREAK IN SECTION H BY MEANS OF CONCRETE BLOCKS

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Paving Statistics for 1921

Paving activities last year took a long step toward pre-war conditions. Cities large and small in all sections of the country did considerable amounts of paving, using all of the standard materials. To name only three large cities, Los Angeles laid 620,000 square yards, Chicago laid 793,000 square yards, and New York City 2,120,000 square yards; the amount spent by these three cities for paving being $1,719,679, $3,266,600 and $9,386,160 respectively, or nearly 14½ million dollars by these three cities alone.

In response to questionnaires sent by us, paving officials of about seven hundred cities have sent figures and information concerning last year's paving and this year's prospects. In order to permit tabulation for this issue, we have used only the replies that had reached us several days ago, when 485 were on hand. Data from the remainder, including those that may still be received, will be tabulated and published in a later issue.

In addition to the figures for paving done, we obtained other valuable information which we will present in instalments in succeeding issues of PUBLIC WORKS. This includes descriptions of the methods used by the several cities in resurfacing old pavements; of changes made in design or specifications for the several kinds of pavement; and the methods of making assessments or raising in other ways the funds for payment for paving work.

This information will, we believe, be of great value to paving officials, as it furnishes facts relative to the amount of each class of pavement laid in every section of the country, the unit cost, the trend of development of methods in laying pavement and paying for it, and the probable amount of work that will be done in 1922.

Paving Prospects for 1922

More paving will be done by cities in 1922 than was done in 1921, and the cost, whether done by contract or by day labor, will be less.

This is already indicated by a number of conditions and by reports from various sources. Materials are lower in price, labor is decidedly lower in most sections, and freight rates on many materials have been reduced.

Last year was a good year for contractors, most of them making large profits because of the reduction of prices and wages after the signing of contracts, and those profits will naturally cause an increase in the number of contractors this year, which will tend to lower contract prices.

These are only indications, but they serve to strengthen more positive evidence pointing in the same direction. This evidence consists of the direct statements made to this paper by more than two hundred city engineers in all parts of the country as to what their cities were expecting to do in the way of paving. It is of course earlier in the year (unfortunately) than most cities decide upon their paving program, and about three hundred engineers preferred not to make any statement, while some of the two hundred reported only what was definitely decided upon. On the other hand, some cities had already contracted for the paving reported. These forecasts would seem therefore, to be as conservatively reliable as such things can be.

According to these, and accepting them as typical of the cities generally, the amount of paving done this year will exceed last year's total by about 40 per cent.

But this rate of increase will not be uniform throughout the country. It will be much greater in the South and much smaller in the North. The average of the cities in the South Atlantic states and that of those in the southern half of the Mississippi basin were, curiously, the same—85 per cent. Averaging all those west of the Rockies, we have a 60 per cent. increase indicated. In the northern half of the Mississippi basin the average is much less—only 13 per cent. In the middle Atlantic states only an 8 per cent. increase is reported. In New England the figures reported show an actual decrease, but the number of engineers there who were able or willing to forecast what their cities would do in the paving line was too small to form a reliable basis.

As suggested, it is probable that the 1922 forecast is conservative. As indicating the attitude of many of the engineers, one wrote: "The pavements indicated for 1922 are all that are assured. Five or six miles more is contemplated."

Altogether, it seems to us that the prospects for city paving are better this year than they have been for several years past.

Recent Legal Decisions

QUESTION OF ELEVATION IN CONSTRUCTION OF SIDEWALKS

In Houston Belt & Terminal Ry. Co. v. Scheppelman, 235 S. W. 206, an action against a railway company for injuries to a pedestrian by a sidewalk made defective by the railway's construction of a sewer under a permit from the city, the court said, though the question of original construction was only indirectly involved in the case: "In constructing sidewalks it becomes necessary in many instances, on account of the topography of the land, to deal with elevation. In such instances, the municipality may overcome the elevation in such manner as the judgment of the proper officials having charge of the highways may dictate, and its duty to the public is discharged, provided that ordinary care is exercised to make them reasonably safe for the purpose of travel. It often results that steps are used to overcome elevation, and that there is no uniformity insofar as evenness and equality of surface are concerned; but whether the required standard has been applied by the municipality in constructing them is generally a question for the jury's determination."

CITY NOT REQUIRED TO PROVIDE FOR DRAINAGE OF ABUTTING PROPERTY ON RAISING GRADE OF STREET

The Arizona Supreme Court holds, City of Globe v. Moreno, 202 Pac. 230, that a city which has done nothing more than raise the grade of a street in front of an abutting owner's property, is under no obligation to provide drains to protect from storm and flood waters the owner's property, which has been made lower than the level of the street.

FACTS INSUFFICIENT TO SHOW NEGLIGENCE OF CITY OR CONTRACTOR REPAVING STREET

In an action for personal injuries against a city and a construction company which had repaved a street under a contract with the city it appeared that the plaintiff, in the night-time, while walking to her home, came to the street while it was in process of being repaired. At or near the point where she entered the street, the contractor had placed a barricade across the repaved portion, and had stationed a watchman, who spoke to the plaintiff and told her not to walk in the street, but to stay on the sidewalk until she got to the alley, or crossing; then she could go out into the street. Before reaching the alley she started across the park strip to get into the street, and was injured by falling over some pieces of iron water pipe which the contractor had left lying lengthwise on the parking. The plaintiff claimed that the city and the contractor owed her the duty to give her warning of the presence of the water pipe, or to have placed lights thereon. The Kansas Supreme Court holds, Conley v. Kansas City, 202 Pac. 607, that these facts failed to show negligence on the part of the defendants. It is also held that an instruction to the jury limiting the city to the use of certain methods of precaution is misleading and erroneous, since the city is required to use only such means as are reasonably sufficient to warn pedestrians of the dangerous condition of the street. Judgment for the plaintiff was reversed, and judgment directed for the defendants.

TIME OF INJURY BY DEFECTIVE STREET OR BRIDGE MUST BE ADEQUATELY STATED

The Vermont Supreme Court holds, Southood v. Town of Cambridge, 115 Atl. 497, that a notice to a town of injuries caused by an alleged defective bridge, dated July 3, 1919, and stating that the injuries were received on Sunday, June 15th, without stating the year, did not comply with the statutory requirement that the time must be stated, since the selectmen are not supposed to enter upon a calendar reckoning to ascertain the time the injury was received.

STATE HIGHWAY CONTRACTOR, ON FAILURE OF STATE'S ASSURANCES TO HAVE CULVERT OVER RAVINE COMPLETED, NOT OBLIGED TO MAKE DETOUR

A state highway contractor, unable to continue work under his contract because a culvert over a ravine had not been constructed pursuant to his contract, was repeatedly assured by the state that the culvert would soon be in its place. In a claim by the contractor against the state for damages, the New York Court of Claims holds, J. W. Brennan Const. Co. v. State, 191 N. Y. Supp. 253, that the contractor was justified in keeping his steam shovel on the completed side of the ravine, in position to resume work when the culvert was completed, and was not obliged to assume that the state's assurances were worthless and to expend the considerable sum and effort required to make a detour to resume work on the other side of the ravine

RIGHT TO COMPENSATION FOR EXCAVATION BELOW SUBGRADE UNDER ROAD CONSTRUCTION CONTRACT

A contract for the construction of a concrete highway for a county provided for "all excavation of every description without classification including all incidental work for the price of 60c. per cubic yard." Oil was encountered and excavated below the finished subgrade. The county contended that "the removal of the oil cakes was work incidental to the grading." It is held, W. Gillivray Const. Co. v. Hoskins (Cal. App.) 202 Pac. 677, that the contract contemplated compensation for such excavation. The decision of the engineer that the contract did not provide for payment on account of excavation below the subgrade was not conclusive, notwithstanding a provision in the contract that the engineer's decision should be final on questions arising during the progress of the work as to what was required by the contract and in what manner it was to be done. When the contractor has followed the decision of the engineer and performed the contract in accordance with that decision, then, it is held, it becomes a question of law whether the former is entitled to compensation for any particular item of work done.

Paving Statistics for 1921

Facts and figures obtained direct from the paving officials of more than seven hundred municipalities give an excellent idea of the work done throughout the country last year. Only a part of the data from a part of the cities is given in this issue. The rest will follow in successive future issues

Table No. 1—City Paving Done in 1921

1—Sheet Asphalt and Asphalt Concrete

Name of City	Sheet Asphalt Area	Sheet Asphalt Cost	Asphalt Concrete Area	Asphalt Concrete Cost
Alabama:				
Bessemer	45,000	.....	....	.....
Fairfield	....	.....	2,929	$10,844.00[x]
Gadsden	....	.....	30,000	2.75[b]
Arkansas:				
Fayetteville	....	.....	10,000	3.00[b]
Little Rock	38,500	$1.80[e]	17,800	3.25[e]
Pine Bluff	40,000	3,000.00[b]	....	.....
California:				
Los Angeles	205,175	550,706.00[e]	24,737	84,111.00[e]
San Francisco	16,556	47,700.00[e]	172,971	404,748.00[e]
Vallejo	....	.....	2,900	.....
Colorado:				
Boulder	....	.....	100,000	3.75[e]
Connecticut:				
Hartford	83,278	70,931.82[e]	....	.....
New Britain	600	2.11	....	.....
New Haven	61,691	130,000.00[x]	....	.....
Illinois:				
Centralia	14,581	4.30[b]	....	.....
Chicago	584,137	3.28-3.91[n]	....	.....
Chicago Heights	....	.....	8,700.2	40,361.00[x]
East Moline	....	.....	10,110	64,926.00[x]
Joliet	....	.....	78,500	3.04[b]
La Grange	4,000	3.60[b]	7,000	2.10[b]
Ottawa	....	.....	13,313	3.11[b]
Peoria	22,955	1.90[e]	....	.....
Danville	20,000	2.47[e]	....	.....
Indiana:				
Elkhart	15,300	86,700.00	....	.....
Fort Wayne	92,153	457,213.08[x]	58,197	286,145.51[x]
Gary	34,652	1.80[e]	....	.....
La Porte	43,991.27	179,390.60	....	.....
South Bend	29,935	4.17[b]	44,997	3.60[b]
Iowa:				
Des Molnes	65,920.16	216.063.53[e]	137,316.11	548,366.71[e]
Fort Dodge	....	.....	65,000	3.49[e]
Iowa City	15,000	3.72[b]	....	.....
Newton	....	.....	11,825	4.49[b]
Oskaloosa	....	.....	94,000	3.97
Kansas:				
Ottawa	17 blocks	.....	....	.....
Parsons	....	.....	20,500	25,513.65[b]
Topeka	....	.....	42,242.9	126,728.70
Wichita	15,980	2.84-3.85[b]	44,100	2.78-3.60[b]
Kentucky:				
Paris	20,000	100,000.00[b]	....	.....
Lonisiana:				
New Orleans	7,088	26,807.00	....	.....
Maine:				
Portland	....	.....	6,043.67	22,575.30
Massachusetts:				
Lynn	....	.....	3,106	1.34[e]
Springfield	40,000	1.93[x]	....	.....
Michigan:				
Detroit	1,794,450	.....	19,250	.....
Grand Rapids	57,709	263,765.00[e]	....	.....
Highland Park	8,233.94	48,213.65[x]	6,958.49	37,844.37[x]
Midland	9.072.1	3.49	2,173.3	3.35
Niles	....	.....	13,000	3.20[b]
Minnesota:				
Minneapolis	....	.....	76,131	294,359[e]
St. Paul	80,071	216,905.00[x]	11,544	50,957.00[x]
Mississippi:				
Clarksdale	....	.....	11,000	3.75[b]
Greenwood	....	.....	40,000	3.97[b]
Missouri:				
Kansas City	280 mi.	193,260.00	.71 mi.	43,250.00
St. Louis	70,185	237,643.85	....	.....
Nebraska:				
Lincoln	10,627	3.10[e]	28,376	2.80[e]
Nebraska City	....	.....	28,000	2.65
Nevada:				
Reno	....	.....	102,300	204,903.00[e]
New Jersey:				
Bayonne	....	.....	29,767	.....
Fort Lee	15,193	2.75[s]	....	.....
Newark	54,248	4.00	....	.....
New York:				
Albany	9,543	$31,777.66[e]	16,946	$64,977.02[e]
Binghamton	....	.....	12,156	65,003.00[e]
Buffalo	243,651	1,081,581.76[x]	....	.....
Fulton	....	.....	8,260	2.85
Geneva	....	.....	15,000	3.50
Brooklyn Boro	600,000	3.89[e]	....	.....
Bronx Boro	1,912,960	2.57[e]	7,911	2.07[e]
Manhattan Boro	140,900	851,200[x]	612	3,100[x]
Queens Boro	80,000	150,000	45,000	95,000
Richmond Boro	....	.....	22,694	2.49[e]
Niagara Falls	8,093	45,495.15[x]	....	.....
Poughkeepsie	19,385	$5,485.00[e]	....	.....
Rochester	264,422	3.15[b]	....	.....
Schenectady	....	.....	70,758	238,155.83[x]
Ohio:				
Akron	41,068	278,699.00	....	.....
Alliance	37,770.7	.32[b]	....	.....
Cleveland	88,370	240,300.00[x]	10,410	35,120.00[x]
Cuyahoga Falls	36,307	4.25-5.90[b]	....	.....
Fremont	10,067	56,127.00[x]	....	.....
Lakewood	6,500	3.50[b]	24,776	3.27[b]
Lancaster	9,135	38,909.50[x]	....	.....
Lima	1,879	7,400.00[x]	....	.....
Salem	....	.....	12,700	1.49[e]
Sandusky	27,751	3.24[b]	....	.....
Toledo	2,586	3.55[b]	6,264	4.36[b]
West Park	....	.....	14,540	82,796.00[x]
Oklahoma:				
Sapulpa	....	.....	7,450	35,773.00[x]
Oregon:				
Portland	....	.....	279,614	769,237.00
Salem	....	.....	8,081	23,092.00
Pennsylvania:				
Ashley	9,500	.....	....	.....
Beaver Falls	....	.....	17,000	4.15[b]
Chester	....	.....	7,190	3.49-3.53[e]
Oil City	28,020	1.70[a]	....	.....
Pittsburgh	146,000	3.75[b]	....	.....
Wilkes-Barre	19,231.18	79.128.75[x]	....	.....
York	23,950	3.65	....	.....
Rhode Island:				
Westerly	6,550	.95[b]	....	.....
South Carolina:				
Columbia	70,000	2.76[b]	....	.....
Spartanburg	4,270	.....	36,025	.....
Tennessee:				
Clarksville	....	.....	40,000	4.00[b]
Cleveland	30,117	88,844.00[b]	....	.....
Johnson City	....	.....	40,000	120,000.00[e]
Texas:				
Beaumont	5,870	4.60[e]	....	.....
Wichita Falls	....	.....	40,050	230,000.00
Virginia:				
Danville	23,140	25,155.25[e]	32,432	99,223.75[e]
Norfolk	56,866	130.520.00[e]	....	.....
Washington:				
Seattle	2,686	2.80[b]	....	.....
West Virginia:				
Parkersburg	14,500	2.30[a]	....	.....
Wisconsin:				
Appleton	29,837	3.96[e]	....	.....
Green Bay	9,200	3.75[b]	....	.....
Madison	24,390	3.10[b]	2,926	2.40[b]
Mllwaukee	203,665	736,564.00[b]	....	.....

[a] Includes wearing surface only. [b] Includes wearing surface and base. [c] Includes wearing surface, base and grading. [x] Includes wearing surface, base, excavation and miscellaneous, such as curb, sewers, etc.

[e] Includes 8-in. base and two applications of sand-asphalt surface treatment [c] Includes 14-in. concrete base in car tracks. [d] Surface treated. [f] $4.25 per cu. yd. of crushed stone in place and 19 cts. per gal. for tar. [g] Scarifying and rolling old macadam, building up base and placing wearing surface. [h] Dressed and redressed granite. [j] Grading $1.25 per cu. yd.; curbing $1.25 per ft.; paving includes 10-in. granulated slag, brick and asphalt filler $3.00 per sq. yd. [k] Of this total, 2,500 sq. yds. are 3-in. V. F. brick, including 4-in. concrete base, at $3.87, and 18,600 sq. yds. are 3-in. V. F. brick on natural soil at $2.60. [m] Total includes 3,200 sq. yds. brick on sand base at $2.17, and 7,949 sq. yds. on concrete base at $5.00. [n] 2-in. top, natural asph., $3.91; oil asph., $3.72; 1½ in. top, natural asph., $3.50; oil asph., $3.28.

II—Tar Concrete and Warrenite-Bitulithic

Name of City	Tar Concrete		Warrenite-Bitulithic	
	Area	Cost	Area	Cost
Alabama:				
Bessemer	....	.....	60,000	$307,000.00[b]
Montgomery	....	.....	18,352	3.60-3.40[e]
Arizona:				
Tucson	....	.....	8 mi.	2.80[e]
Arkansas:				
Little Rock	....	.....	31,800	1.90[a]
California:				
Eureka	....	.....	1,814	2.83[b]
Los Angeles	....	.....	93,606	302,609.00[e]
Colorado:				
Trinidad	....	.....	43,700	2.75[b]
Georgia:				
Columbus	....	.....	40,000	33,926.54[a]
Idaho:				
Boise	....	.....	1,718	2.30[b]
Iowa:				
Des Moines	....	.....	5,583.79	19,235.26[e]
Orange City	....	.....	40,000	3.99
Kansas:				
McPherson	2,000	$2.54	....	.....
Louisiana:				
New Orleans	....	.....	56,457	368,083.00
Massachusetts:				
Cambridge	....	.....	64,081	3.00[x]
Minnesota:				
Hibbing	....	.....	47,634	5.30[b]
Rochester	....	.....	32,000	4.24[e]
Missouri:				
St. Louis	....	.....	87,695	345,585.20
New Hampshire:				
Laconia	376	752	....	.....
New Jersey:				
Bloomfield	....	.....	43,000	140,000.00
East Orange	....	.....	5,862	17,943[bs]
Irvington	....	.....	25,000	3.70[b]
New York:				
Middletown	....	.....	10,600	4.65[a]
New Rochelle	....	.....	3,433	3.25-3.45[a]
Niagara Falls	....	.....	10,431	64,387.37[x]
No. Tonawanda	....	.....	36,080	157,330.00[e]
Oneida	....	.....	20,577	3.95[e]
North Carolina:				
Greensboro	....	.....	12,000	38,000.00[x]
Wilson	....	.....	78,000	3.90[b]
North Dakota:				
Fargo	....	.....	37,467	244,020.00[e]
Ohio:				
Hillsboro	....	.....	17,000	4.73[e]
Oregon:				
Klamath Falls	....	.....	10,839	2.94[x]
Pennsylvania:				
Lebanon	....	.....	21,866	3.56-3.90
Rhode Island:				
Pawtucket	....	.....	2,528	4.00
South Carolina:				
Columbia	....	.....	40,000	2.76[b]
Texas:				
Dallas	....	.....	231,431.21	108,402.31[x]
Fort Worth	....	.....	94,409.94	350,000.00[b]
Waxahachie	....	.....	94,993	380,553.20[x]
Washington:				
Puyallup	....	.....	5,418	17,091.00[x]
Wyoming				
Casper	....	.....	2,500	2.53[b]

For footnotes see page 121

III—Asphalt Macadam and Tar Macadam

Name of City	Asphalt Macadam		Tar Macadam	
	Area	Cost	Area	Cost
Alabama:				
Gadsden	15,000	.....	....	.....
Arkansas:				
Little Rock	43,000	2.75[b]	....	.....
California:				
Napa	4,066	76½[s]	....	.....
So. Pasadena	45,667	60,000[e]	....	.....
Connecticut:				
New Haven	74,341	180,000[x]	....	.....
Putnam	1,000	2.00[b]	....	.....
Florida:				
Fort Myers	....	.....	4,000	.....
Sanford	15,000	1.54[b]	....	.....
St. Augustine	3 mi.	1.50	....	.....
Georgia:				
Rome	18,000	2.30[b]	....	.....
Illinois:				
Bloomington	2,000	1.40[e]	....	.....
Chicago	155,935	$3.08	....	.....
Danville	....	.....	5,000	2.80[b]
Indiana:				
West Lafayette	9,600	3,700[e]	....	.....
Kansas:				
Wichita	8,000	1.75[b]	....	.....
Kentucky:				
Ashland	....	.....	1,996.50	5.45[x]
Missouri:				
Frederick	....	.....	10,111	5,714[a]
Mass.				
Andover	....	.....	1 mi.	.....
Brockton	45,400	2.00[e]	....	.....
Cambridge	....	.....	62,556	1.75[x]
Dartmouth	6,800	6,762[e]	31,972	28,473[e]
Easthampton	....	.....	5,400	2.35[e]
Lawrence	92,783	1.62	....	.....
Lynn	52,689	1.63[e]	....	.....
Provincetown	....	.....	5 mi.	1,000
Quincy	69,572	168,695[x]	....	.....
Springfield	75,000	1.76[e]	8,500	1.89[e]
Webster	....	.....	1,600	2,500[e]
Michigan:				
Grand Rapids	....	.....	20,220	27,480[x]
Ironwood	....	.....	11,800	.....
Minnesota:				
Red Wing	....	.....	6,160	11,045[e]
St. Paul	....	.....	13,240	23,288[x]
Missouri:				
Carthage	....	.....	21,319	19[d]
Jefferson City	7,610	1.00-1.40[b]	....	.....
Kansas City	7.62 mi.	172,310	....	.....
St. Louis	23,010	49,456.75	....	.....
Webster Grove	....	.....	25,000	5,000[d]
New Hampshire:				
Laconia	24,731	.....	....	.....
New Jersey:				
Bloomfield	10,000	35,000	....	.....
East Orange	....	.....	2,700	2,160
Englewood	63,360	79,200[e]	....	.....[f]
Fort Lee	....	.....	10,800	[b]
Freehold	....	.....	900	.....
Garfield	26,570	46,182[e]	....	.....
Montclair	7,300	25,800[x]	....	.....
Newton	6,660	.81[a]	....	.....
Nutley	....	.....	1,800	4,700[x]
Summit	....	.....	4,000	1.25[e]
New York:				
Dansville	....	.....	1,500	.....
Haverstraw	22,000	30,000	....	.....
Herkimer	1,400	.30[a]	....	.....
Little Falls	....	.....	1,165	2.10[b]
Brooklyn Boro.	24,000	1.68	....	.....
Queens Boro	275,000	.....	....	.....
Richmond Boro	35,430	2.67[e]	....	.....
Oneonta	400	1.85[e]	....	.....
Poughkeepsie	11,565	29,316[e]	....	.....
Rochester	....	.....	9,000	2.62[b]
Plattsburgh	20,000	2.20[b]	....	.....
Ohio:				
Akron	....	.....	16,080	1.21
Bucyrus	....	.....	1 mi.	.....
Lima	....	.....	16,737	56,958.17[x]
Pennsylvania:				
Norristown	....	.....	1 mi.	28,000
Parkesburg	....	.....	11,700	2,000
Sewickley	....	.....	1,800	1.07
Uniontown	....	.....	5,264	3.30[x]
Rhode Island:				
Pawtucket	....	.....	18,148	2.00[b]
Westerly	....	.....	10,280	1.65[b]
Woonsocket	51,600	2.00	....	.....
So. Carolina:				
Greenville	400	2.00[x]	....	.....
Tennessee:				
Jackson	20,000	1.15[e]	....	.....
Virginia:				
Norfolk	4,800	6,500	....	.....
Salem	6,200	2.50[e]	....	.....
W. Virginia:				
Bluefield	1,200	3.00[b]	....	.....
Wisconsin:				
Kaukauna	....	.....	18,053	1.20[e]
Lake Geneva	....	.....	100	.....
Madison	2,455	2.12[b]	....	.....
Milwaukee	....	.....	288,373	193,121
Wausau	....	.....	4,000	8,000

For footnotes see page 121

IV—Stone Block and Brick

Name of City	Stone-Block		Brick	
	Area	Cost	Area	Cost
Alabama:				
Selma	.....	.....	15,000	.....
California:				
San Francisco	.....	.....	2,881	14,681[e]
Colorado:				
Trinidad		.....	12,400	3.70[b]
Connecticut:				
Hartford	2,910	20,031.54[e]	.....	.....
New Haven	309	2,400	1,055	19,500
Florida:				
St. Petersburg	.....	.....	200,000	2.65[e]
Georgia:				
Columbus	.....	.....	110,331	404,774.35

Name of City	Stone-Block		Brick	
	Area	Cost	Area	Cost
Illinois:				
Bloomington	.....	.....	14,000	4.50[e]
Canton	.....	.....	6,900	3.72[e]
Chicago	4,688.00	7.00-7.39[p]	28,601.00	5.70-5.85[x]
Danville	.....	.....	30,000	2.63[a]-4.05[b]
East Moline	.....	.....	5,830	43,189.66
Jacksonville	.....	.....	6,570	35,000.00
Murphysboro	.....	.....	20,000	90,000.00[x]
Peoria	.....	.....	6,738	2.80[b]
Indiana:				
Elkhart	.....	.....	7.800	44,300.00
Fort Wayne	.....	.....	4,219	31,874.83[x]
Lafayette	.....	.....	10,448	3.95[e]
Iowa:				
Cedar Rapids		....	5,020	26,375.00[x]
Des Moines	.....	.....	61,866.65	228,487.30[e]
Iowa City	.....	.....	600	4.50[b]
Kansas:				
Chanute	.....	.....	11,363	44,899.62[x]
Dodge City	.....	.....	30,000	3.90[b]
Ottawa	.....	.....	10 blocks	.....
Parsons	.....	.....	3,500	3.04[b]
Pratt	.....	.....	40,000	3.98[b]
Topeka	.....	.....	2,891.5	11,912.98
Wichita	.....	.....	70,000	3.98-4.35[b]
Kentucky:				
Ashland	.....	.....	11,021	8.32—8.48[x]
Covington	.....	.....	5,300	3.25[b]
Louisiana:				
Lake Charles	.....	.....	7,000	4.00
New Orleans	8,020	172,693	.....	.....
Maine:				
Portland	4,482.67	15,350.20[e]	2,138.23	15,133.66[e]
Massachusetts:				
Brockton	1,657	2.85[e]	.....	.....
Cambridge	7,000	3.00[x]	.....	.....
Holyoke	4,600	.....	.....	.....
Lawrence	2,865	6.04	.....	.....
Lynn	22,116	2.59[e]	.....	.....
Pittsfield	.....	.....	8,587	4.88[e]
Springfield	4,264	7.03[e]	.....	.....
Michigan:				
Battle Creek	.....	.....	11,904	2.65[e]
Detroit	30,648	.....	48,912	.....
Grand Rapids	.....	.....	10,615	50,000.00[x]
Niles	.....	.....	1,400	7.00[c]
Minnesota:				
Minneapolis	14,400.00	72,000.00[e]	25,651.00	129,042.00[e]
Rochester	.....	.....	17,000	5.00[e]
St. Paul	.....	.....	51,318	265,686[x]
Winona	.....	.....	2,100	1.38
Mississippi:				
Hattiesburg	.....	.....	24,100	102,291[x]
Missouri:				
Jefferson City	.....	.....	2,640	4.00[b]
Kansas City	44 mi.	53,420	3.83 mi.	276,000
St. Charles	.....	.....	1,333	4.50[e]
St. Louis	5,640	50,285.10	33,116	213,627.90
Nebraska:				
Fremont	.....	.....	1,400	4.24[e]
Lexington	.....	.....	42,500	4.25[e]
Lincoln	.....	.....	10,990	4.07[e]
Nebraska City	.....	.....	40,000	3.61
Omaha	.....	.....	94,137	390,881.33[b]
New Jersey:				
Newark	36,279	3.50	.....	.....
New York:				
Albany	16,746.8	72,730.61[b]	3,448.4	14,461.12[e]
Binghamton	.....	.....	1,726	11,307[e]
Buffalo	.....	.....	8,686	43,471[x]
Corning	.....	.....	19,053	111,810.71[x]
Dansville	.....	.....	6,000	30,000[x]
Glens Falls	.....	.....	1,307.07	3.65[e]
Br'klyn Boro	30,600.00	7.76[e]	.....	.....
Bronx Boro	86,681.00	5.93[e]	.....	.....
M'h't'n Boro	186,700.00	1,960,110.00[x]	.....	.....
R'hm'nd Boro	33,000.00	.....	.....	.....
Queens Boro	31,219.00	6.47[e]	.....	.....
Niagara Falls	.....	.....	22,422	148,669.50[x]
Olean	.....	.....	52,300	2.51[x]
Poughkeepsie	.....	.....	1,752	11,156.00[e]
Rochester	.....	.....	1,040	4.85[b]
Schenectady	4,642	.....	.....	.....
Watertown	.....	.....	8,469	4.30[e]
North Dakota:				
Fargo	.....	.....	19,265	142,584.00[e]
Ohio:				
Akron	.....	.....	42,705	2.40[e]
Ashtabula	.....	.....	21,261	5.15-5.22[x]
Barnesville	.....	.....	27,000[e]	9,431.00
Bellaire	.....	.....	1,539	5.30[x]
Cleveland	22,102	209,700.00[x]	186,830	1,187,930.00[x]
Cuyahoga Falls	.....	.....	5,330	4.90[b]
Jackson	.....	.....	10,523	42,000.00[b]
Lancaster	.....	.....	14,702	54,166.55[x]
London	.....	.....	12,000	.....
Lorain	.....	.....	14,558	95,871.79[x]
Middletown	.....	.....	8,220	4.20[e]
Nelsonville	.....	.....	1,140	19,161.10[x]
New Boston	.....	.....	10,870	3.54[b]
Niles	.....	.....	10,433	60,040.00[e]
Oberlin	.....	.....	2,800	15,000.00[x]
Salem	.....	.....	13,000	1.74
Toledo	5,550	6.25[b]	8,791	4.35[b]
Ohio—Continued.				
Wooster	.....	.....	7,000	38,000.00
Zanesville	.....	.....	9,338	31,599.00[x]
Pennsylvania:				
Carrick	.....	.....	6,638	22,394.20[b]
Clearfield	.....	.....	1,000	.....
Connellsville	.....	.....	12,419	58,585.00[x]
Duquesne	7,515	6.70	.....	.....
Farrell	.....	.....	34,300	3.05-3.30[e]
Greensburg	.....	.....	9,247.4	3.38[b]
Greenville	.....	.....	4,000	4,000.00
Huntingdon	.....	.....	4,500	3.92[e]
Kingston	.....	.....	5,240	4.90[e]
North Braddock	.....	.....	1,006	3.15
Oil City	.....	.....	3,500	3.35-3.45[b]
Pittsburgh	27,400	5.00[b]	33,000	3.60[b]
Pottstown	.....	.....	13,722.81	41,460.09
Rankin	.....	.....	2,500	10,000.00
St. Marys	.....	.....	3,416	18,276.00[e]
Wilkinsburg	.....	.....	1.62 mi.	82,338.00[j]
Williamsport	.....	.....	7,546	3.76[e]
York	.....	.....	775	5.25
Rhode Island:				
Pawtucket	895	.....	.....	.....
South Carolina:				
Spartanburg	.....	.....	2,300	.....
Texas:				
Amarillo	.....	.....	19,000	55,000.00
Cisco	.....	.....	21,100[k]	2.60-3.87
Eastland	.....	.....	17,542	5.14[e]
Fort Worth	.....	.....	32,787.38	100,000.00[b]
Texarkana	.....	.....	125,000	3.60-4.15
Virginia:				
Danville	11,082	62,292.00[e]	.....	.....
Norfolk	6,328	9,818.27[s]	.....	.....
Washington:				
Seattle	1,969	6.00[b]	59,991	5.00[b]
West Virginia:				
Fairmont	.....	.....	111.47[m]	2.17-5.00
Parkersburg	.....	.....	10,100	6.80[e]
Wheeling	.....	.....	10,992	105,850.00
Wisconsin:				
Madison	.....	.....	437	5.25[b]
Milwaukee	30,321.69	170,934.55[b]	.....	.....
Sparta	.....	.....	1 block	.....
Wisconsin Rapids	.....	.....	2,500	.....

P—Granite block $7.00, sandstone block $7.39.

Paving Notes

OTHER KINDS OF PAVEMENT

In addition to the paving tabulated, certain other kinds were reported from various cities but from too few to warrant a separate column in the table. Among the pavements so reported are the following:

Vibrolithic, Montgomery, Ala., 33,403 square yards at $3.25 and Brazil, Ind., 1,000 square yards at $3.35.

Sheet asphalt on old macadam, Hartford, Conn., 19,918 square yards. Sheet asphalt on brick, Danville, Ill., 20,000 square yards at $2.47.

Aspalt block, Fort Myers, Fla., 29,000 square yards; Lockport, N. Y., 21 mi.; and Rochester, N. Y., 380 square yards at $5.55.

Rock asphalt, Kansas City, Mo., .73 mi.; Arlington, Mass., 1,410 square yards; Chanute, Kans., 7,806 square yards; Covington, Ky., 15,000 square yards at $3.50; Beaumont, Tex., 12,400 square yards at $3.00; Dallas, Tex., 59,846 square yards; and Denton, Tex., 26,412 square yards at $2.35.

Amiesite, Stratford, Conn., 2,000 square yards; Hazleton, Pa., 510 square yards; and Kingston, Pa., 7,020 square yards at $3.95.

Willite, Lima, Ohio, 3,498 square yards; Kingston, N. Y., 50,000 square yards; Mt. Vernon, N. Y., 75,000 square yards; Waterford, N. Y., 21,000 square yards; Cohoes, N. Y., 5,000 square yards; Great Bend, Ore., 75,000 square yards; Holland, Mich., 25,000 square yards, and Willite on old brick, Connellsville, Pa., 18,086 square yards.

Hassam bicomac, Portland, Me., 6,044 square yards. Hassam compressed concrete, Arlington, Mass., 3,721 square yards.

National pavement, East Orange, N. J., 18,600 square yards on telford and 9,322 on concrete.

Shell, Beaumont, Tex., 37,500 square yards at $.90.

Durax, Norfolk, Va., 13,383 square yards.

Resurfacing tar macadam, Caruthersville, Mo., 52,000 square yards at $.15. Asphalt resurfacing, Montclair, N. J., 21,000 square yards 3 inches thick; Akron, Ohio, 122,400 square yards; Danville, Va., 39,187 square yards; Fredericksburg, Va., 6,600 square yards at $.05; and Milwaukee, Wis., 45,373 square yards. Asphalt concrete resurfacing, Fulton, N. Y., 39,000 square yards 2 inches thick at $1.87; and Portland, Ore., 48,825 square yards. Brick resurfacing, Sandusky, Ohio, 12,927 square yards at $2.54.

COST OF GRADING

In our paving questionnaire, the informants were asked to state, in reporting the cost of paving, what items were included in the sum named. The majority included only surface and foundation or surface only, but a number stated that the cost named covered not only paving but also curbs and gutters, sewers, catch basins, and in some cases sidewalks and other items of street improvement. It is apparent that where the cost included items other than wearing surface and base, the figure of cost given meant very little since it was impossible to know what percentage of the cost was for pavement only and what for the other features of the street improvement.

Of those that included in the cost, items other than surface and base, probably the majority included only grading in addition thereto. In Iowa the grading included in cost of pavement is that displaced by the new pavement, any additional excavation being paid for extra, this being required by law if assessments for paving are to be legal. However, even with this understanding, there is nothing to indicate whether the material removed was simply natural soil or was old macadam or telford, or what was the depth of material removed when this was less than the pavement thickness.

In a few instances the engineers reported the cost of grading separate from the paving. For instance, in Globe, Ariz., in laying 27,325 square yards of concrete pavement, there was 7,513 cubic yards of grading which cost $17,655, or more than 13 per cent of the entire cost of the improvement. In Longmont, Colo., where concrete pavement cost $2.25 not reinforced and $2.48 reinforced, the grading cost in addition to this is $1.00 per cubic yard. In Boise, Ida., $2.60 per square yard paid for warrenite-bitulithic included $.30 per square yard for grading. In Edwardsville, Ill., grading constituted 9 per cent of the total cost of the one-course concrete pavement. In Ottawa, Ill., excavating cost $.70 per cubic yard, and in St. Charles, Ill., $.75. In Hiawatha, Kans., grading cost $1.00 per yard and in Pratt, Kans., $.98. In Detroit, Mich., the cost of sheet asphalt, including an 8-inch concrete base, stone curb, excavation, etc., averaged $6.28 per square yard, while the top only averaged $2.00; the cost of asphalt concrete including a 6-inch concrete base, excavation, etc., averaged $5.46 and the top only $1.10. In laying one-course concrete in alleys the average price was $2.05 without excavation and $2.75 including excavation.

(To be continued)

Table No. 1—City Paving Done in 1921—V.—Creosoted Wood Block, Concrete Reinforced and Concrete Not Reinforced

	Creosoted Wood Block		Concrete, Reinforced		Concrete, Not Reinforced	
	Area	Cost	Area	Cost	Area	Cost
Alabama:						
Montgomery	....	.....	....	.....	33,403.00	3.25
Arizona:						
Globe	....	.....	....	.....	27,325.00	132,526.00*
Tucson	....	.....	....	.....	2,000.00	3.32*
Arkansas:						
Little Rock	....	.....	.....	.....	22,500.00	3.25*
Pine Bluff	....	.....	27,670	.....	.....	.....
California:						
Calexico	....	.....	....	.....	100	900.00
Los Angeles	....	.....	....	.....	96,409.00	442,993.00*
Napa	....	.....	....	.....	4,900.00	24,500.00*
Palo Alto	....	.....	....	.....	45,000.00	65,800.00*
San Bernardino	....	.....	....	.....	98,747.00	144,800.00
San Francisco	....	.....	....	.....	16,139.00	48,559.00*
Santa Maria	....	.....	....	.....	2,667.00	40,000.00
Vallejo	....	.....	....	.....	4,220.00	.....
Whittier	....	.....	....	.....	24,888.00	57,679.00*
Colorado:						
Longmont	....	.....	25,375	2.48*	7,194.00	2.25*
Connecticut:						
Bristol	....	.....	....	.....	22,500.00	41,600.00*
Hartford	....	.....	....	.....	2,800.00	.....
New Haven	....	.....	....	.....	15,847.00	27,000.00*
Norwich	....	.....	....	.....	.....	60,000.00
Rockville	....	.....	....	.....	460	.....
Georgia:						
Athens	....	.....	....	.....	27,589.00	61,000.00
Missouri:						
Carthage	....	.....	....	.....	.....	.....
Kansas City	....	.....	....	.....	.....	.....
Sedalia	....	.....	....	.....	.....	.....
Springfield	....	.....	....	.....	.....	.....
St. Louis	....	.....	6,735	55,068.75	11,565	69,264.30
Nebraska:						
Fremont	....	.....	....	.....	.....	.....
Lincoln	....	.....	....	.....	.....	.....
Omaha	....	.....	1,928	9,689.20*	.....	.....
Sioux City	....	.....	....	.....	.....	.....
Nebraska:						
Reno	....	.....	....	.....	....	.....
New Hampshire:						
Laconia	....	.....	....	.....	....	.....
New Jersey:						
Bayonne	....	.....	....	.....	5,839	2.75
Freehold	....	.....	....	.....	60,000	.....
Irvington	....	.....	....	.....	38,000	2.50*
Millville	....	.....	....	.....	13,000	2.78
Newton	....	.....	....	.....	28,169	3.35
Nutley	....	.....	....	.....	2,854	3.38*
New York:						
Albany	....	.....	....	.....	3,245	3.616*
Binghamton	....	.....	....	.....	17,554	.....
Fulton	....	.....	....	.....	6,737	1.87*
Gloversville	....	.....	....	.....	18,764	64,049*

	Concrete, Not Reinforced	
	Area	Cost
Missouri:		
Carthage	20,514	2.66⅔*
Kansas City	3.11 mi.	210,000
Sedalia	440	1,097.80*
Springfield	6,000	2.55*
St. Louis	28,780	84,993.14
Nebraska:		
Fremont	22,143	3.11*
Lincoln	7,247	2.60*
Omaha	7,853	26,009.47*
Sioux City	72,000	3.84
Nebraska:		
Reno	5,000	9,900
New Hampshire:		
Laconia	49	.....
New Jersey:		
Bayonne	.....	.....
Freehold	.....	.....
Irvington	.....	2.50*
Millville	.....	.....
Newton	.....	.....
Nutley	.....	.....
New York:		
Albany	688.3	8,909.01*
Binghamton	.....	.....
Fulton	.....	.....
Gloversville	.....	.....

Illinois:						
Benton	....	.....	17,891	3.47[a]	.....	.....
Bloomington	....	.....	3,036	3.50[a]	233	300[a]
Champaign	....	.....	30,500	103,000.00	.....	.....
Chicago	53,075	7.00	....	.....	15,891	3.43
Chicago Hgts.	....	.....	....	.....	2,115.00	9,591.00[x]
Edwardsville	....	.....	....	.....	3,183.00	10,436.00[e]
East Alton	....	.....	21,500	.....	.....	.....
East Moline	....	.....	5,856.4	17,322.8[x]	.....	.....
Evanston	....	.....	....	.....	1,940.00	.....
Joliet	6,300	4.25[b]	....	.....	.....	.....
Marion	....	.....	10,732	3.65[a]	.....	.....
Ottawa	....	.....	13,400	2.78[a]	.....	.....
Quincy	2,808	5.40[a]	4,200	4.25[a]	.....	.....
St. Charles	....	.....	14,200	2.77[a]	.....	.....
Indiana:						
Brazil	....	.....	....	.....	5,000	3.33[x]
Covington	....	.....	9,200	40,000[c]	.....	.....
Elwood	....	.....	....	.....	4,500	3.90[a]
Fort Wayne	....	.....	....	.....	3,641	9,305.38[x]
Gary	....	.....	94,771	3.40[x]	22,676	2.45
Kendallville	....	.....	15,000	58,500	.....	.....
Lafayette	....	.....	....	.....	4,419	2.07[a]
Marion	....	.....	....	.....	756	.....
New Albany	....	.....	1,620	.....	16,850	.....
Noblesville	....	.....	....	.....	137,580[a]	27,500
Portland	....	.....	10,000	35,025[x]	.....	.....
South Bend	....	.....	....	.....	4,058	2.57[b]
Iowa:						
Ames	....	.....	45,173.62	157,507.63[a]	.....	.....
Atlantic	....	.....	....	.....	4,000	4.25
Cedar Rapids	....	.....	....	.....	9,374	28,451[x]
Cherokee	....	.....	1,795	10,706.97[a]	4,206	10,593.70[a]
Clinton	....	.....	78,986	282,678	.....	.....
Des Moines	....	.....	....	.....	39,314.44	134,297.85[a]
Iowa City	....	.....	35,000	3.12[b]	.....	.....
Newton	....	.....	1,945	5.59[b]	.....	.....
Ottumwa	....	.....	10,000	55,402[a]	.....	.....
Perry	....	.....	....	.....	40,000	3.99[a]
Kansas:						
Atchison	....	.....	....	.....	900	2.56
Chanute	....	.....	....	.....	1,890	4,351.46[x]
Hiawatha	....	.....	900	2.74[a]	.....	.....
McPherson	....	.....	....	.....	2,000	2.54[a]
Topeka	....	.....	....	.....	15,970.1	40,847.09
Wichita	....	.....	....	.....	70,725	1.83-2.75[a]
Maine:						
Portland	....	.....	....	.....	2,097.63	7,820.35[a]
South Parls	....	.....	....	.....	17,520	.....
Massachusetts:						
Athol	....	.....	3,510	8,000[a]	.....	.....
Brockton	....	.....	....	.....	4,900	4.32[a]
Holyoke	....	.....	13,000	.....	28,000	.....
Millbury	....	.....	1½ mi.	87,000	.....	.....
Pittsfield	.....		12,500	3.07[a]	13,768	3.49[a]
Michigan:						
Alma	....	.....	....	.....	30 064	2.65
Ann Arbor	....	.....	....	.....	2,000	.....
Detroit	....	.....	....	.....	292,746	.....
Grand Rapids	....	.....	72,533	324,270[x]	.....	.....
Highland Park	....	.....	....	.....	14,799.97	45,242.94[x]
Owosso	....	.....	....	.....	17,000.00	2.47[a]
Minnesota:						
Chisholm	....	.....	13,500	3.80[a]	.....	.....
Crookston	....	.....	7,000	.....	.....	.....
Duluth	....	.....	115,000	2.60[a]	.....	.....
Faribault	....	.....	520	3.83[a]	.....	.....
Minneapolis	96,216	506,030[a]	....	.....	37,934	126,684[a]
Rochester	6,000	6.00[a]	....	.....	2.000.00	3.42[a]
St. Paul	55,509	341,203[x]	66,355	194,748[x]	.....	.....
Two Harbors	....	.....	145,000	45,508[x]	.....	.....
Gouverneur	....	.....	....	.....	3,028	1.17-1.70[a]
Herkimer	....	.....	7,000	3.10[a]	.....	.....
Hudson	....	.....	....	.....	17,000	36,000
Lackawanna	....	.....	500	6,700[x]	.....	.....
Little Falls	....	.....	3,750	3.99[a]	.....	.....
Lockport	....	.....	3.3 mi.	213,775.29	.....	.....
Middletown	....	.....	20,000	3.58[a]	.....	.....
Manhattan Boro..	5,085	62,800[x]	....	.....	.....	.....
Queens Boro.....	17,000	.....	.....	.....	.....	.....
Richmond Boro...	....	.....	134,760	5.78[a]	14,942	4.24[a]
Olean	....	.....	10,800	2.45-3.00[a]	.....	.....
Port Chester.....	....	.....	....	.....	5,300	17,134.00[a]
Port Jervis	....	.....	4,256	3.58[a]	.....	.....
Poughkeepsie	....	.....	15,073	61,594.00[a]	.....	.....
Schenectady	....	.....	1,085.6	4,505.94[x]	.....	.....
North Carolina:						
Asheville	....	.....	....	.....	1,836	4,500
Marion	....	.....	....	.....	15,000	2.00[a]
Mount Airy	....	.....	....	.....	18,464	40,915.16
North Dakota:						
Fargo	....	.....	708	2,785.00[a]	.....	.....
Ohio:						
Akron	....	.....	1,943	9,399.10	.....	.....
Bellaire	....	.....	4,499	4.05[a]	.....	.....
Lakewood	....	.....	15,629	3.80[b]	.....	.....
Lorain	....	.....	27,308	118,682.48[x]	.....	.....
Sandusky	....	.....	13,444	2.50[b]	.....	.....
Toledo	....	.....	14,963	3.50[a]	1,032	2.78[a]
West Park	....	.....	4,268	21,370.00[x]	.....	.....
Oklahoma:						
Ada	....	.....	....	.....	10 blocks	56,000
Oregon:						
Astoria	....	.....	....	.....	19,478	98,954.00[x]
Eugene	....	.....	....	.....	3,000	1.17[a]
Oregon City	....	.....	1,400	2.65[a]	4,600	2.50[a]
Portland	....	.....	....	.....	125,540	404,639.00[x]
Salem	....	.....	....	.....	17,685	45,895.00
Pennsylvania:						
Carrick	....	.....	440	1,254.00[b]	.....	.....
Du Bois	....	.....	300	4.00[x]	1,700	3.60
Lebanon	....	.....	29,479	2.75-3.10[a]	.....	.....
Munhall	....	.....	....	.....	14,905	58,780.00[a]
Pittsburg	....	.....	7,000	3.25[b]	14,000	3.25[b]
Tyrone	6,400	461[a]	....	.....	.....	.....
Wilkinsburg	....	.....	⅛ mi.	8,680.00	.....	.....
South Carolina:						
Greenville	....	.....	....	.....	5,200	3.85[x]
South Dakota:						
Mitchell	....	.....	450	.....	.....	.....
Tennessee:						
Cleveland	....	.....	....	.....	7,612	19,214.00[b]
Texas:						
Cisco	....	.....	2,000	3.45[a]	.....	.....
Forth Worth	....	.....	....	.....	1,283.22	3,600.00[b]
Waxahachie	....	.....	....	.....	2,958	.....
Wichita Falls	....	.....	40,113	228,100.00	9,000	41,900.00
Utah:						
Logan	....	.....	3,434	2.70	.....	.....
Vermont:						
Barre	....	.....	3,226	3.13-3.27[a]	.....	.....
Rutland	....	.....	17,133	2.90	.....	.....
Virginia:						
Newport News	....	.....	....	.....	8,090	2.10-4.00
Petersburg	....	.....	5,500	2.67[a]	22,000	3.13[a]
Suffolk	....	.....	....	.....	2,600	3.00
Washington:						
Bellingham	....	.....	....	.....	22,333	61,679.00[a]
Chehalis	....	.....	....	.....	12,113	2.50[a]
Dayton	....	.....	....	.....	7,200	21,000.00[a]
Puyallup	....	.....	....	.....	14,920	50,700.00[x]
Raymond	....	.....	....	.....	2,050	10,140.00[x]
Seattle	....	.....	....	.....	313,444	2.45[b]

For footnotes see page 121

	Creosoted Wood Block		Concrete, Reinforced		Concrete, Not Reinforced	
West Virginia:	Area	Cost	Area	Cost	Area	Cost
Bluefield	....	.....	....	.....	1,000	2.75
Fairmont	....	.....	....	.....	4,526	2.89-3.00
Parkersburg	....	.....	19,500	2.05-2.65*	.....	.....
Wheeling	....	.....	4,442	21,611.18	.....	.....
Wisconsin:						
Edgerton	....	.....	17,000	2.56*	.....	.....
Fond du Lac	....	.....	25,000	3.25	.....	.....
Lake Geneva	....	.....	....	.....	10,000	20,000.00
Madison	4,639	5.50[9]	7,400	2.10*	.....	.....
Manitowoc	....	.....	70,000	3.16*	.....	.....
Marshfield	....	.....	15,000	3.35	.....	.....
Oshkosh	....	.....	9,694	23,263.35*	6,241	18,062.00*
Randolph	....	.....	....	.....	30,000	2.99
Sheboygan	....	.....	80,148	187,165.00*	.....	.....
Superior	....	.....	6,000	17,000.00[x]	.....	.....
Waukesha	....	.....	....	.....	12,700	2.25-2.50
Wausau	....	.....	....	.....	500	1,500.00
Wisconsin Rapids	....	.....	....	.....	28,000	2.69

For footnotes see page 121

VI—Waterbound Macadam, Gravel, and Cement Sidewalks

	Waterbound Macadam		Gravel		Cement Sidewalks	
Name of City	Area	Cost	Area	Cost	Area	Cost
Alabama:						
Bessemer	.....	.....	.....	.....	2,400	.....
Gadsden	.....	.....	10,000	.....	5,200	.....
Montgomery	.....	.....	15,275	.63-1.08	.....	.....
			5,000	.....	.....	.....
Arizona:						
Globe	.....	.....	.....	.....	9,473	3,315.00
Arkansas:						
De Queen	.....	.....	48,000	600.00	.....	.....
Fayetteville	3,000	1.10	.....	.....	20,000*	.25
Little Rock	.....	.....	16†	.....	.....	.....
California:						
Alameda	2,500	4,272.00[x]	.....	.....	.....	.....
Berkeley	.....	.....	.....	.....	200,000*	.24
Calexico	.....	.....	.....	.....	1†	.....
Eureka	.....	.....	.....	.....	87,000*	.14
Los Angeles	.....	.....	.....	.....	1,460,941*	362,526.00
Palo Alto	.....	.....	.....	.....	13,500*	.20
San Bernardino	.....	.....	.....	.....	.....	5,000.00
San Francisco	.....	.....	.....	.....	20,573	36,929.00
Santa Maria	.....	.....	.....	.....	20,000*	.20
So. Pasadena	.....	.....	.....	.....	5,000	750.00
Whittier	.....	.....	.....	.....	2,203	3,768.00
Colorado:						
Pueblo	.....	.....	.....	.....	4,000	.....
Connecticut:						
Manchester	5,072	.95	.....	.....	80,000*	.16
New Britain	12,000	.85	.....	.....	.....	.21
Rockville	2,200	3,000.00*	.....	.....	2,500	8,545.00
Stratford	.....	.....	6†	1.00‡	.....	.....
Williamantic	.....	.....	.....	.....	43,284*	.....
Florida:						
Fort Lauderdale	26,000	.81[8]	.....	.....	2,000*	.21½
Sanford	.....	.....	.....	.....	6,000	.25
St. Petersburg	.....	.....	.....	.....	10,000	1.53
Georgia:						
Athens	.....	.....	.....	.....	40,000*	6,800.00
Columbus	.....	.....	.....	.....	5,894	7,662.20
Rome	28,000	1.60	79,000	1.20	9,000	2.00
Idaho:						
Boise	.....	.....	.....	.....	73,500*	.18
New Ulm	.....	.....	.....	.....	3,800	1.09
Rochester	.....	.....	10,000‡	1.60	26,000	1.60
St. Paul	.....	.....	.....	.....	13†	43,386.00
Winona	.....	.....	.....	.....	11,760	1.17
Mississippi:						
Canton	.....	.....	.....	.....	400*	.25
Missouri:						
Joplin	835	470.00	.....	.....	.....	.....
Kansas City	.....	.....	.....	.....	5.22†	39,500.00
Sedalia	.....	.....	.....	.....	10,000*	2,000.00
Springfield	.....	.....	.....	.....	2,700	2.21
St. Charles	.....	.....	.....	.....	1,000*	.20
St. Louis	.....	.....	.....	.....	37,089*	15,651.00
Webster Grove	.....	.....	.....	.....	4,000	10,400.00
Montana:						
Havre	.....	.....	16,000	.12	.....	.....
Nebraska:						
Lincoln	.....	.....	.....	.....	123,645*	.19
Omaha	.....	.....	.....	.....	501,000*	100,320.00
Scottsbluff	.....	.....	.....	.....	24,000*	.17
Nevada:						
Reno	.....	.....	.....	.....	4,500	8,100.00
New Jersey:						
East Orange	.....	.....	.....	.....	2.852*	616.20
Englewood	.....	.....	.....	.....	6,000§	7,040.00
Fort Lee	.....	.....	.....	.....	3,200*	.34
Freehold	.....	.....	.....	.....	1†	.....
Garfield	.....	.....	.....	.....	115,300*	39,558.00
Irvington	.....	.....	.....	.....	10,000	.....
Montclair	.....	.....	.....	.....	10,000*	3,000.00
Newark	.....	.....	.....	.....	103,635	.26
Newton	.....	.....	6,100	.....	.....	.....
Phillipsburg	1,200	3,000.00	.....	.....	.....	.....
Summit	7,200	.75	.....	.....	3,300*	.30
Wallington	.....	.....	.....	.....	21,947*	4,833.00
New York:						
Albany	.....	.....	.....	.....	74,564.11	20,805.46
Binghamton	.....	.....	.....	.....	.....	15,000.00
Buffalo	.....	.....	.....	.....	5.24†	.66
Corning	.....	.....	.....	.....	1,435‖	1,793.75
Gloversville	.....	.....	25,717	45,298.00	.....	.....
Herkimer	.....	.....	4,500	.80	1,200*	.20
Hornell	.....	¼†	.....	1†	.....	.....
Hudson	5,000	5,000.00	.....	.....	.....	.....
Hudson Falls	.....	.....	.....	.....	2,500*	.25
Lackawanna	.....	.....	.....	.....	900	3,890.00
Lockport	.....	.....	.....	.....	550§	736.00
New Rochelle	.....	.....	.....	.....	39,600*	.32
Niagara Falls	.....	.....	.....	.....	10,220*	2,368.34
No. Tonawanda	.....	.....	.....	.....	40,000*	.18
Portchester	.....	.....	.....	.....	7†	.30*
Rochester	.....	.....	.....	.....	70,177*	.20
Schenectady	.....	.....	.....	.....	8,134*	3,929.44
Watertown	10,000	2.00	.....	.....	19,000*	.25
North Carolina:						
Asheville	.....	.....	.....	.....	675	656.00
Greensboro	.....	.....	.....	.....	4,400	.....
North Dakota:						
Fargo	.....	.....	.....	.....	6,195	12,315.00
Ohio:						
Akron	.....	.....	.....	.....	840,000*	168,000.00
Alliance	.....	.....	.....	.....	25,000*	5,500.00
Ashtabula	.....	.....	.....	.....	20,000*	.22
Cuyahoga Falls	.....	.....	.....	.....	100,003*	.21½
Fostoria	.....	.....	.....	.....	5,000‖	750.00
Jackson	.....	.....	.....	.....	10,000*	2,500.00
Lancaster	.....	.....	.....	.....	2†	.....
Lima	.....	.....	.....	.....	15,640	32,000.00
Sidney	.....	.....	.....	.....	2,500	.20
Oklahoma:						
Ada	.....	.....	40¶	16,000.00	.....	.....

Illinois:						
Bloomington					35,000	.185
Champaign					15†	1.15-1.20
Chicago Heights					12,000*	.25
Danville					40,000*	.18
East Moline					7,000*	1,200.00
Evanston					10,177	18,876.86
Kewanee					16,427*	3,675.00
Streator					50,000*	12,500.00
Indiana:						
Bloomington	4,000	1.20			12,000*	.22
Brazil					2,000	.25
Covington			3,000	3,000.00	2,000*	.20
Elkhart					46,600*	9,700.00
Fort Wayne					4,981	35,376.17
Gary					5,117	3.00
Lafayette			4,673§	1.80	71,500*	.18-.20
Marion					10,000*	
New Albany					35,920*	
Noblesville					26,960*	4,313.60
South Bend	6,684	2.15			113,115*	.18
West Lafayette			4,100	5,550.00	850	1,350.00
Iowa:						
Boone					100,000*	
Cedar Rapids					87,000*	
Des Moines					236,173*	47,036.51
Emmetsburg					1,400	2,300.00
Newton					450	1.44
Ottumwa					9,000§	.15*
Kansas:						
Dodge City					15,000	.14
Ottawa					3¶	
Parsons	2,000	1.56			5,000*	.18
Salina					6,000*	.18
Topeka					8,078	2,019.50
Wichita					110,000*	.18
Kentucky:						
Ashland					10,475	.32
Covington					30,000*	1.30
Louisiana:						
La Fayette			50,000	.80		
New Orleans			7,088	26,807.00	41,693	84,433.00
Maine:						
Augusta			1.5†		620‖	
Gardiner			1,600			
Portland						2,696.27
Waterville			16,600	7,480.00	700	2,800.00
Massachusetts:						
Andover					600‖	
Arlington					17,563.8*	7,025.52
Athol			2†	8,500.00	1,334	4,200.00
Brockton			25,600		8,300	1.95
Dartmouth			17,000			
Easthampton					1,700	.23
Lawrence					3,099	2.20
Lynn					8,846	3.21
Orange			1†	5,000.00		
Pittsfield					7,275	3.10
Springfield					7,500	2.33
Webster					2,242	4,050.00
Michigan:						
Ann Arbor			6†		5,000*	
Battle Creek					90,250*	.12
Hastings			2†		½†	
Ironwood					200,000*	.22
Manistique					1/5†	1,150.00
Niles					20,000*	.14
Owosso					30,000*	.16
Ypsilanti					30,000*	.20
Minnesota:						
Chisholm					30,000*	.26
Cloquet			1†	2.00‡	26,308*	.16½-.20
Duluth					18†	.22
Faribault			15,000	.20		
Hibbing			80,000		223,200*	.25
Hugo			3,000	1,500.00		
Sapulpa					42,000*	.16-.24
Oregon:						
Astoria	10,261	29,150.00			3,395*	
Eugene			20,000	.60	32,000§	.16
Klamath Falls					20,270*	.28
Oregon City					2,000	1.20
Portland	25,439	57,527.00			383,137*	
Pennsylvania:						
Berwick					54,000*	.16
Clearfield					500	2.00
Du Bois					2,000	1.98
Duquesne					10,500*	
Freeland	3,000	2,100.00			1,000	27,000.00
Greenville					400§	.25
Norristown	1,000	.90				
Oil City					19,914*	.25
Parkesburg	5,066	690.00			682	1,342.00
Slatington					1,000‖	
Shippensburg					3,360*	.15
Walnutport					3,000‖	
Wilkinsburg					½†	.25*
Williamsport					65,000*	.26
Rhode Island:						
Pawtucket	1.13†		0.35†		4,060	
Westerly			2†	2,000.00	1,200‖	1.85¹
South Carolina:						
Chester			23,000	2,300.00	988.4	2,407.04
Greenville					2,000	2.50
Spartanburg					3,000	
Tennessee:						
Clarksville	2†					
Cleveland					5,500	9,700.00
Jackson			10,000	.70		
Texas:						
Beaumont					2,350	1.80
Bonham			55,590	1.60	3,100	2.25
Cameron			2¾†	12,000.00	½†	1,320.00
Cisco					1,000	.25
Dallas					577,511*	115,502.20
Denton			15,000	.62		
Mineral Wells					63,000*	
Vermont:						
Springfield			6,222	1,100.00		
Virginia:						
Norfolk					1,500	1,645.76
Petersburg			192,000	.18	14,400	1.63
Salem	6,000	1.00				
Suffolk					2,778	1.71
Washington:						
Bellingham					9.843*	234,475.00
Dayton					20,000*	4,000.00
Okanogan			60	9,500.00	2,500§	32,000.00
Puyallup			12,940§	8,303.00		
Raymond					1,200	2.25
Seattle			30,200‡		100,000	1.60
West Virginia:						
Bluefield					21,000*	.30
Fairmont	8,513	1.78				
Wisconsin:						
Green Bay					32,000*	.22
Lake Geneva			1,000		500*	
Milwaukee					501,037*	124,450.73
New London					6,000	
Oshkosh					2 5†	13,200.00
Sheboygan					4,000§	4,400.00
Superior					45,000*	12,000.00
Wausau			7,000	6,500.000	62,400*	11,232.00
Wisconsin Rapids			16,000		2½†	.15*
Wyoming:						
Casper					250,000	60,000.00
Sheridan					2.5†	19,800.00

Explanation: *—Square Feet. †—Miles. ‡—Cubic Yards. §—Lineal Feet. ¶—Blocks. ‖—Feet. ¹—Square Yards. For additional footnotes see page 121.

Table 2—Cost of Sand, Gravel and Crushed Stone

Name of City	Cost, delivered on the street, of Sand	per	Gravel	per	Crushed stone	per
Alabama:						
Fairfield	3.25	cu. yd.	....	.....	2.30	ton
Gadsden	1.50-2.50	cu. yd.	....	.....	2.50	ton
Montgomery	.75	ton	1.20	ton	....	.....
Selma	1.00	yd.	.85	yd.	....	.....
Arizona:						
Globe	1.50	cu. yd.	1.50	cu. yd.	2.50	cu. yd.
Tucson	1.50	cu. yd	....	.....	3.00	cu. yd.
Arkansas:						
De Queen	....	.....	1.00	cu. yd.	....	.....
Fayetteville	2.80	cu. yd.	2.25	cu. yd.	3.25	cu. yd.
Helena	1.50	cu. yd.	2.00	cu. yd.	2.50	ton
Little Rock	2.50	cu. yd.	....	.....	1.75	ton
Texarkana	2.75	cu. yd.	3.20	cu. yd.	4.50	cu. yd.
California:						
Alameda	2.50	yd.	3.05	yd.	3.00	yd.
Calexico	4.00	yd.	3.75	yd.	....	.....
Eureka	1.75	cu. yd.	2.00	cu. yd.	....	.....
Los Angeles	1.50	ton	1.90	ton	2.00	ton
Napa	1.50	cu. yd.	2.00	cu. yd.	2.25	cu. yd.
Palo Alto	1.60	ton	1.60	ton	3.00	cu. yd.
Porterville	1.00	yd.	....	.....	2.20	yd.
San Bernardino	.75	cu. yd.	.75	cu. yd.	2.75	cu. yd.
San Francisco	1.50	cu. yd.	2.25	cu. yd.	2.25	cu. yd.
Santa Maria	1.20	yd.	2.00	ton	2.50	ton
So. Pasadena	1.75	yd.	2.00	yd.	3.00	yd.
Vallejo	2.75	cu. yd.	2.75	cu. yd.	2.75	cu. yd.
Whittier	2.25	ton	2.75	ton	3.00	ton
Colorado:						
Boulder	1.50	sq. yd.	1.50	sq. yd.	1.50	sq. yd.
Longmont	1.50	cu. yd.	1.50	cu. yd.	....	.....
Pueblo	1.25	cu. yd.	1.10	cu. yd.	2.10	cu. yd.
Salida	1.50	cu. yd.	1.50	cu. yd.	1.50	cu. yd.
Trinidad	3.50	cu. yd.	....	.....	3.00-3.50	cu. yd.
Connecticut:						
Bristol	.70	cu. yd.	1.00	cu. yd.	1.75	ton
Manchester	1.00	yd.	1.00	yd.	2.50	ton
Meriden	....	.....	....	.....	1.25-1.90	ton
New Britain	1.25	cu. yd.	....	.....	1.50	ton
New Haven	1.50	cu. yd.	.75	cu. yd.	1.80	cu. yd.
Norwich	2.00	cu. yd.	....	.....	3.00	cu. yd.
Putnam	1.50	yd.	1.50	yd.	2.25-3.00	ton
Rockville	1.65	yd.	1.65	yd.	2.20	ton
Willimantic	1.80	yd.	1.80	yd.	.75	yd.
Florida:						
Fort Lauerdale	1.25-1.35	cu. yd.	....	.....	1.75-1.95	cu. yd.
Fort Myers	1.50-2.50	cu. yd.	....	.....	3.50 & up	cu. yd.
Gainesville	2.00	cu. yd.	....	.....	6.00	cu. yd.
Sanford	2.10	ton	....	.....	2.75	ton
St. Augustine	2.00	cu. yd.	2.00	cu. yd.	3.75	cu. yd.
St. Petersburg	5.00	yd.	....	.....	6.00	yd.
Georgia:						
Athens	.50	cu. yd.	3.50	ton	4.00	ton
Columbus	1.00	cu. yd.	2.50	cu. yd.	3.25	cu. yd.
Griffin	1.10	cu. yd.	1.25	cu. yd.	1.25	cu. yd.
Rome	1.25	cu. yd.	1.50	cu. yd.	2.00	cu. yd.
Idaho:						
Boise	1.50	cu. yd.	2.00	cu. yd.	4.00	cu. yd.
Illinois:						
Beardstown	1.88	ton	1.88	ton	2.40	ton
Benton	1.90	ton	2.90	ton	2.40	ton
Bloomington	1.85	ton	1.85	ton	2.00	ton
Canton	1.50	ton	2.20	ton	3.00	ton
Centralia	2.26	ton	....	.....	2.36	ton

Name of City	Cost, delivered on the street, of Sand	per	Gravel	per	Crushed stone	per
Louisiana:						
La Fayette	2.00	ton	3.50	ton	....	.....
Lake Charles	2.50	cu. yd.	4.00	cu. yd.	....	.....
Maine:						
Augusta	.25	l'd (abt. 1 yd.)	.15	yd.	.95	yd.
Portland	2.00	cu. yd.	2.00	cu. yd.	2.00	ton
Waterville	2.00	yd.	2.50	yd.	....	.....
Maryland:						
Frederick	3.00	ton	....	.....	2.95	ton
Massachusetts:						
Athol	1.20	sq. yd.	1.25	sq. yd.	1.50	sq. yd.
Brockton	2.50	yd.	2.50	yd.	3.25	ton
Cambridge	1.25	ton	2.00	ton	2.38	ton
Dartmouth	....	.....	....	.....	2.40	ton
Easthampton	....	.....	....	.....	2.85	ton
Holyoke	.75	yd.	....	.....	2.00	ton
Lawrence	2.25	cu. yd.	3.50	cu. yd.	1.30	ton
Pittsfield	1.60	cu. yd.	2.00	cu. yd.	2.70	ton
Provincetown	.60	ton	....	.....	4.00	ton
Quincy	4.00	cu. yd.	4.00	cu. yd.	2.10	ton
Springfield	2.00	yd.	3.00	yd.	2.20-1.85	ton
Webster	3.00	yd.	2.00	yd.	1.50	ton
Michigan:						
Alma	2.20	cu. yd.	2.40	cu. yd.	2.40	cu. yd.
Ann Arbor	1.50	cu. yd.	2.00	cu. yd.	....	.....
Detroit	2.30	cu. yd.	3.00	cu. yd.	3.00	ton
Dowagiac	1.50	yd.	1.50	sq. yd.	....	.....
Grand Rapids	.80	cu. yd.	1.20	cu. yd.	1.35	cu. yd.
Hastings	....	.....	1.00	yd.	....	.....
Highland Park	1.50	ton	2.50	ton	....	.....
Holland	.75	yd.	2.55	1½ yd.	....	.....
Ironwood	2.00	cu. yd.	....	.....	2.50	cu. yd.
Midland	2.25	cu. yd.	2.25	cu. yd.	....	.....
Niles	1.00-1.25	yd.	....	.....	....	.....
Owosso	2.50	load (1¼ yds.)	2.00	load	....	.....
Sault Ste. Marie	1.80	yd.	1.80	yd.	1.65-3.50	ton
Ypsilanti	1.00	cu. yd.	1.50	cu. yd.	3.00	ton
Minnesota:						
Albert Lea	1.50	cu. yd.	2.00	cu. yd.	....	.....
Chisholm	2.00	cu. yd.	....	.....	3.50	cu. yd.
Cloquet	2.00	cu. yd.	2.00	cu. yd.	....	.....
Crookston	1.75	yd.	3.00	yd.	4.25	yd.
Duluth	1.70	yd.	....	.....	2.00-4.00	yd.
Faribault	2.10	cu. yd.	3.10	cu. yd.	....	.....
Hibbing	1.20	sq. yd.	1.25	sq. yd.	3.00	sq. yd.
Minneapolis	1.75	cu. yd.	2.75	cu. yd.	2.75	cu. yd.
New Ulm	1.10-1.20	cu. yd.	.90	cu. yd.	....	.....
Red Wing	.35	.....	1.30	.....	....	.....
Rochester	1.20	yd.	3.05	cu. yd.	2.75	cu. yd.
St. Paul	1.25	cu. yd.	2.25	cu. yd.	2.25	cu. yd.
Two Harbors	1.30	cu. yd.	1.30	cu. yd.	1.90	cu. yd.
Willmer	1.25	yd.	2.75	yd.	3.50	yd.
Winona	1.50	cu. yd.	2.50	cu. yd.	....	.....
Mississippi:						
Clarksdale	3.00	cu. yd.	3.25	cu. yd.	3.50	cu. yd.
Greenwood	1.50	cu. yd.	2.25	cu. yd.	3.20	cu. yd.
Hattiesburg	1.75	cu. yd.	1.75	cu. yd.	....	.....
Natchez	2.00	cu. yd.	1.75	cu. yd.	4.50	ton
Missouri:						
Caruthersville	1.50	cu. yd.	1.75	cu. yd.	3.50	cu. yd.
Jefferson City	1.60	cu. yd.	3.00	cu. yd.	2.50	cu. yd.
Joplin	1.00	cu. yd.	1.00	cu. yd.	1.00	cu. yd.
Kansas City	2.50	cu. yd.	....	.....	2.60	cu. yd.
Poplar Bluff	2.00	yd.	2.25	yd.	3.00	yd.
Sedalia	2.00	cu. yd.	2.00	cu. yd.	3.50	cu. yd
Springfield	2.30	ton	2.20	ton	2.75	ton
St. Charles	2.50	cu. yd.	3.50	cu. yd.	1.90	ton
St. Louis	2.05	ton	2.15	ton	2.00	ton
Webster Grove	2.05	ton	2.00	ton	9.00	square
Montana:						
Havre	2.50	cu. yd.	2.50	cu. yd.	....	.....
Nebraska:						
Fremont	1.65	cu. yd.	2.00	cu. yd.	....	.....

Champaign	3.25	cu. yd.	3.25	cu. yd.	3.25	cu. yd.
Chicago	2.97	cu. yd.	2.97	cu. yd.	2.35	cu. yd.
Chicago Heights	2.50	cu. yd.	2.10	cu. yd.	2.10	cu. yd.
Danville	1.50	cu. yd.	1.70	ton	1.75	ton
Edwardsville	1.50	ton	2.00	ton	2.10	ton
East Moline	1.90	cu. yd.	2.50	cu. yd.	2.50	cu. yd.
Evanston	3.00	cu. yd.	3.00	cu. yd.	3.00	cu. yd.
Galena	2.25	cu. yd.	2.50	cu. yd.	....	.....
Jacksonville	1.40	ton	2.30	ton	2.40	ton
Joliet	2.25	cu. yd.	2.00	cu. yd.	2.00	cu. yd.
Kewanee	2.00	ton	2.65	ton	2.80	ton
La Grange	2.75	cu. yd.	2.50	cu. yd.	2.50	cu. yd.
Marion	2.60	ton	2.75	ton	2.50	ton
Mattoon	2.80	cu. yd.	3.10	cu. yd.	3.10	cu. yd.
Morrison	2.90	.....	2.90	.....	....	.....
Ottawa	2.75	cu. yd.	2.75	cu. yd.	3.00	cu. yd.
Peoria	1.70	ton	1.80	ton	3.25	ton
Quincy	2.00	cu. yd.	....	.....	2.25	ton
Streator	1.66	ton	1.65	ton	1.70	ton
Waukegan	3.50	cu. yd.	3.50	cu. yd.	3.50	cu. yd.
Wheaton	1.75	cu. yd.	1.75	cu. yd.	1.80	cu. yd.
Wilmette	2.75	cu. yd.	2.75	cu. yd.	2.75	cu. yd.
Indiana:						
Bloomington	2.00	yd.	2.00	yd.	1.85	yd.
Brazil	2.75	yd.	2.50	cu. yd.	3.00	cu. yd.
Covington	.50	yd.	.75	ton	2.50	ton
Crawfordsville	1.50	yd.	1.50	yd.	2.75	yd.
Elkhart	1.50	cu. yd.	2.00	cu. yd.	2.00	cu. yd.
Ellwood	3.00	cu. yd.	3.00	cu. yd.	3.00	cu. yd.
Fort Wayne	2.10	ton	2.48	ton	2.89	ton
Jasper	4.50	cu. yd.	4.35	cu. yd.	2.75	cu. yd.
Kendallville	1.25	cu. yd.	1.50	cu. yd.	....	.....
Lafayette	1.50	cu. yd.	1.50	cu. yd.	1.75	cu. yd.
La Porte	1.75	cu. yd.	3.50	cu. yd.	3.02	ton
Marion	1.50	yd.	1.50	yd.	2.25	.....
Mt. Vernon	1.12½	cu. yd.	1.12½	cu. yd.	....	.....
New Albany	1.60	ton	1.60	ton	2.15	ton
Noblesville	1.25	yd.	1.25	yd.	....	.....
North Vernon	2.00	cu. yd.	2.00	cu. yd.	2.00	cu. yd.
Peru	1.00	yd.	1.35	yd.	....	.....
Portland	1.50-1.75	cu. yd.	1.50	cu. yd.	2.00	ton
South Bend	2.25	cu. yd.	2.25	cu. yd.	2.25	ton
Wabash	1.50	cu. yd.	1.25-1.75	cu. yd.	.80-1.00	ton
West Lafayette	2.00	.....	1.50	.....	2.00	cu. yd.
Iowa:						
Boone	1.75	cu. yd.	1.75	cu. yd.	....	.....
Cedar Rapids	1.20	cu. yd.	4.00	cu. yd.	3.00	cu. yd.
Centerville	2.80	ton	....	.....	....	.....
Des Moines	2.25	cu. yd.	2.50	cu. yd.	3.75	cu. yd.
Emmetsburg	1.00	cu. yd.	1.00	cu. yd.	1.65	cu. yd.
Fort Dodge	2.00	yd.	2.00	yd.	2.50	yd.
Indianola	2.00-2.50	yd.	2.25-2.50	yd.	2.50-2.75	cu. yd.
Iowa City	1.30	ton	2.20	ton	1.90	ton
Keokuk	1.75	yd.	....	.....	2.10	cu. yd.
New Hampton	1.35	ton	1.65	ton	....	.....
Newton	1.40	ton	1.75	ton	....	.....
Oelwein	2.00	cu. yd.	2.00	cu. yd.	....	.....
Ottumwa	1.75	cu. yd.	3.00	cu. yd.	4.00	cu. yd.
Perry	1.50	yd.	1.75	yd.	2.50	yd.
Storm Lake	1.25	ton	1.25	ton	....	.....
Kansas:						
Atchison	2.00	yd.	....	.....	2.00	ton
Chanute	2.20	ton	....	.....	2.50	ton
Dodge City	1.50	cu. yd.	1.50	cu. yd.	....	.....
Emporia	2.50	cu. yd.	2.00	cu. yd.	5.00	cu. yd.
Hiawatha	2.40	ton	2.50	ton	2.50	ton
McPherson	2.50	ton	3.50	ton	3.35	ton
Parsons	.12	100 lbs.	....	.....	2.50	cu. yd.
Pratt	.70	cu. yd.	.70	cu. yd.	....	.....
Salina	2.00	yd.	....	.....	3.40	ton
Topeka	1.50	yd.	3.00	yd.	3.50	yd.
Wichita	1.25-1.50	cu. yd.	....	.....	....	.....
Kentucky:						
Ashland	2.50-2.75	cu. yd.	....	.....	....	.....
Covington	2.25	ton	2.50	ton	3.00	ton
Owensboro	1.10	yd.	1.10-1.37	cu. yd.	....	.....
Lexington	1.40	cu. yd.	1.75	cu. yd.	6.50	ton
Lincoln	1.10	ton	1.55	ton	2.00	ton
Omaha	1.88	ton	2.35	ton	3.45	ton
Scottsbluff	1.00	sq. yd.	1.50	sq. yd.	....	.....
Nevada:						
Reno	1.50	cu. yd.	....	.....	2.75	cu. yd.
Winnemucca	1.50	cu. yd.	1.50	cu. yd.	....	.....
New Jersey						
Bayonne	2.85	cu. yd.	3.50	cu. yd.	3.75	cu. yd.
East Orange	3.00	ton	....	.....	....	.....
Englewood	2.50	yd.	....	.....	3.10	yd.
Fort Lee	4.25	cu. yd.	....	.....	4.25	cu. yd.
Freehold	2.50	ton	2.50	ton	3.75	ton
Garfield	1.75	cu. yd.	....	.....	3.50	cu. yd.
Irvington	2.40	.....	....	.....	3.00	cu. yd.
Millville	1.70	ton	2.80	ton	....	.....
Montclair	3.00	ton	....	.....	2.65-3.25	ton
Newark	....	.....	....	.....	3.65	cu. yd.
Newton	.90	ton	.30	ton	2.00	ton
Nutley	2.00	ton	3.00	ton	2.75	ton
Phillipsburg	2.20	ton	2.40	ton	2.40	ton
Summit	2.15-3.25	cu. yd.	2.00-3.00	cu. yd.	3.40-4.80	cu. yd.
New York:						
Albany	1.96	cu. yd.	2.20	cu. yd.	3.10	cu. yd.
Binghamton	2.50	cu. yd.	2.25	cu. yd.	2.25	ton
Buffalso	1.50-2.10	ton	1.25-1.85	ton	2.25	cu. yd.
Corning	2.00	cu. yd.	2.25	cu. yd.	2.83-3.44	cu. yd.
Dansville	1.75	yd.	2.00	yd.	2.25	yd.
Fairport	2.00	cu. yd.	2.00	cu. yd.	2.50	cu. yd.
Fulton	1.75	cu. yd.	1.75	cu. yd.	1.65	ton
Geneva	2.50	ton	2.50	ton	2.50	ton
Glen Falls	1.50-2.00	cu. yd.	1.50-2.00	cu. yd.	2.50	ton
Gloversville	1.75-2.00	(ld.1½yds.)	1.75-2.00	load	3.00	cu. yd.
Gouverneur	1.50	cu. yd.	2.00	cu. yd.	2.50	cu. yd.
Haverstraw	1.50	cu. yd.	....	.....	3.80	cu. yd.
Herkimer	1.25	yd.	1.25	yd.	3.00	yd.
Hornell	2.00	yd.	2.00	yd.	....	.....
Hudson	2.75	sq. yd.	2.75	sq. yd.	2.50	sq. yd.
Lackawanna	2.50	yd.	....	.....	2.00	yd.
Little Falls	2.50	ton	....	.....	2.50	ton
Lockport	2.85	cu. yd.	3.00	cu. yd.	3.00	cu. yd.
Middletown	2.00	yd.	2.00	yd.	....	.....
New York—						
Brooklyn Boro	1.29	cu. yd.	2.64	cu. yd.	2.19	cu. yd.
Bronx Boro	1.85	cu. yd.	2.70	.....	2.85	.....
Queens Boro	1.57	cu. yd.	....	.....	3.09	cu. yd.
Richmond Boro.	2.75	cu. yd.	....	.....	....	.....
Olean	2.50-3.00	cu. yd.	2.50	cu. yd.	....	.....
Oneida	2.50	cu. yd.	2.50	cu. yd.	2.80	cu. yd.
Oneonta	1.65-2.70	.....	1.50	cu. yd.	2.35	yd.
Plattsburgh	1.00	cu. yd.	1.00	cu. yd.	2.25	ton
Port Chester	3.25	cu. yd.	....	.....	4.50	.....
Port Jervis	1.50	cu. yd.	....	.....	3.50	cu. yd.
Poughkeepsie	3.00	cu. yd.	2.80	cu. yd.	3.00	cu. yd.
Rochester	2.67	cu. yd.	2.67	cu. yd.	2.00	cu. yd.
Schenectady	2.00	cu. yd.	....	.....	3.00	cu. yd.
Watertown	1.00	cu. yd.	1.00	cu. yd.	3.00	cu. yd.
North Carolina:						
Asheville	1.50	.....	....	.....	4.60	yd.
Concord	1.50	yd.	2.05	ton	2.05	ton
Greensboro	1.50	yd.	3.50	cu. yd.	3.50	cu. yd.
Marion	2.00	ton	....	.....	5.00	ton
Mount Airy	....	.....	....	.....	.00-3.50	ton
Wilson	2.00	yd.	....	.....	4.00	yd.
North Dakota:						
Dickinson	3.50	cu. yd.	3.75	cu. yd.	....	.....
Fargo	4.30	cu. yd.	4.20	cu. yd.	4.50	ton
Mandan	2.05	cu. yd.	2.95	cu. yd.	....	.....
Ohio:						
Akron	1.66	ton	2.24	ton	2.65	ton
Alliance	....	.....	2.90	ton	2.75	ton
Ashtabula	2.50	cu. yd.	2.50	cu. yd.	3.50	ton
Barnesville	2.50	cu. yd.	4.00	cu. yd.	6.00	cu. yd.
Bucyrus	1.40	ton	....	.....	1.85	ton
Cleveland	2.25	cu. yd.	2.50	cu. yd.	....	.....
Delaware	.15	bushel	....	.....	2.25	ton

Name of City	Cost, delivered on the street, of—Sand	per	Gravel	per	Crushed stone	per
Ohio (Continued)						
East Palestine	3.25	ton	3.25	ton	3.00	ton
Fostoria	2.00	ton	2.00	ton	1.80	ton
Fremont	1.60	ton	....	.....	1.60	ton
Hillsboro	1.70	ton	1.70	ton	1.80	ton
Jackson	1.75	ton	1.75	ton	2.00	ton
Lakewood	2.25	ton	....	.....	2.75	ton
Lancaster	2.50	cu. yd.	1.25	cu. yd.	2.75	cu. yd.
Lawton	1.00	cu. yd.	1.20	cu. yd.	2.35	ton
Lima	3.00	cu. yd.	....	.....	2.00	cu. yd.
London	2.00	cu. yd.	2.00	cu. yd.	2.25	ton
Marysville	2.00	ton	1.50	ton	1.80	ton
Middletown	1.25	cu. yd.	1.25	cu. yd.	2.35	ton
Mt. Vernon	1.25	yd.	.75	yd.	2.00	yd.
Nelsonville	2.00-2.50	cu. yd.	2.00-2.50	cu. yd.	....	.....
New Boston	2.00	cu. yd.	2.00	cu. yd.	....	.....
Niles	2.20	cu. yd.	....	.....	2.00	cu. yd.
Oberlin	2.23	ton	2.23	ton	....	.....
Salem	2.00	ton	1.75	ton	....	.....
Toledo	2.25	ton	2.25	ton	3.00	ton
Urbana	1.50	cu. yd.	1.00	cu. yd.	....	.....
West Park	3.00	yd.	3.00	yd.	2.25	yd.
Wooster	2.50	yd.	2.50	yd.	3.25	yd.
Zanesville	2.50	ton	2.50	ton	3.50	ton
Oklahoma:						
Ada	2.25	cu. yd.	2.50	cu. yd.	2.60	cu. yd.
Hugo	2.50	cu. yd.	2.50	cu. yd.	2.00	cu. yd.
McAlister	3.50	cu. yd.	3.75	cu. yd.	4.50	cu. yd.
Sapulpa	1.75	yd.	1.55	yd.	1.85	yd.
Shawnee	2.00	cu. yd.	....	.....	2.40	ton
Oregon:						
Astoria	2.25	yd.	3.00-4.00	yd.	2.75-3.50	yd.
Baker	1.75	.....	1.50	cu. yd.	....	.....
Eugene	2.00	cu. yd.	1.75	cu. yd.	1.75	cu. yd.
Klamath Falls	2.75	cu. yd.	....	.....	2.75	cu. yd.
La Grande	1.75	cu. yd.	1.50	cu. yd.	2.25	cu. yd.
Oregon City	1.75	cu. yd.	1.75	cu. yd.	3.00	cu. yd.
Portland	1.10	cu. yd.	1.15	cu. yd.	1.90	cu. yd.
Pennsylvania:						
Ashley	3.75	ton	3.50	ton	4.50	ton
Beaver Falls	2.30	ton	1.85	ton	2.50	ton
Berwick	1.75	cu. yd.	1.75	cu. yd.	2.25	ton
Carrick	.15	bushel	.17	bushel	....	.....
Clearfield	3.50	ton	4.00	ton	3.50	ton
Du Bois	3.50	ton	....	.....	....	.....
Duquesne	2.00	ton	2.00	ton	....	.....
Farrell	2.75	ton	2.50	ton	....	.....
Franklin	2.50	yd.	2.00	yd.	....	.....
Freeland	3.00	ton	2.86	ton	3.25	ton
Greenville	2.75	ton	2.55	ton	....	.....
Hazleton	2.90	ton	3.20	ton	3.75	ton
Huntingdon	1.90	ton	....	.....	2.50	ton
Kingston	2.25-2.50	ton	2.25-2.50	ton	2.50-2.75	ton
Lebanon	2.50	ton	....	.....	2.00	ton
Monongahela	.18	100 lbs.	.16	100 lbs.	....	.....
Munhall	2.15	ton	1.95	ton	....	.....
Norristown	2.50	cu. yd.	....	.....	2.50	ton
Oil City	3.00	cu. yd.	3.00	cu. yd.	....	.....
Parkesburg	....	.....	....	.....	3.00	ton
Pittsburgh	1.25	ton	1.35	ton	....	.....
Pottsville	....	.....	....	.....	2.75	ton
Rankin	2.40	ton	2.20	ton	....	.....
Sewickley	2.50	ton	2.50	ton	4.00	ton
Shippensburg	1.50	ton	2.00	ton	2.50	ton
St. Marys	2.70	ton	....	.....	2.70	ton
Tyrone	3.25	ton	....	.....	3.50	ton
Uniontown	.25	bushel	2.50	ton	2.70	ton
West Homestead	....	.....	....	.....	5.00	ton
Wilkes-Barre	1.75	cu. yd.	1.75	cu. yd.	1.75	cu. yd.
Williamsport	2.25	cu. yd.	2.65	cu. yd.	2.50	cu. yd.
York	....	.....	....	.....	1.30	ton
Rhode Island:						
Pawtucket	....	.....	....	.....	2.75	ton
Westerly	....	.....	.90	ton	2.10	ton
Woonsocket	1.25	load (abt. 1 cu. yd.)	1.50	load	3.25-3.75	ton

Name of City	Cost, delivered on the street, of—Sand	per	Gravel	per	Crushed stone	per
South Carolina:						
Charleston	1.50	cu. yd.	....	.....	3.30	cu. yd.
Columbia	1.00	cu. yd.	....	.....	2.00	ton
Greenville	1.25	yd.	5.00	yd.	2.80	yd.
Spartanburg	1.25	yd.	....	.....	3.50	ton
South Dakota:						
Mitchell	1.50	yd.	....	.....	3.00	ton
Tennessee:						
Clarksville	3.00	yd.	2.50	yd.	2.00	yd.
Cleveland	3.00	ton	3.00	ton	3.50	ton
Jackson	1.10	cu. yd.	2.00	ton	2.00	ton
Texas:						
Amarillo	2.75	yd.	2.25	yd.	....	.....
Beaumont	1.50	cu. yd.	4.25	cu. yd.	....	.....
Bonham	2.05	cu. yd.	2.55	cu. yd.	4.00	cu. yd.
Cameron	4.00	cu. yd.	1.75	cu. yd.	3.80	cu. yd.
Cisco	3.10	cu. yd.	....	.....	3.00	cu. yd.
Dallas	2.50	cu. yd.	2.50	cu. yd.	2.15	cu. yd.
Denton	3.00	cu. yd.	3.00	cu. yd.	3.50	cu. yd.
Eastland	3.50	cu. yd.	3.50	cu. yd.	3.25	cu. yd.
Fort Worth	3.00	cu. yd.	2.75	cu. yd.	3.75	cu. yd.
Mineral Wells	2.50	ton	....	.....	2.80	ton
Texarkana	2.00	yd.	3.00	yd.	....	.....
Waxahachie	2.50-3.50	cu. yd.	3.00-3.50	cu. yd.	....	.....
Wichita Falls	3.75	cu. yd.	3.75	cu. yd.	4.00	cu. yd.
Utah:						
Logan	2.00	cu. yd.	2.00	cu. yd.	2.00	cu. yd.
Vermont:						
Barre	2.00-3.00	truck & team loads.		Same as sand	2.00	ton
Rutland	1.70	cu. yd.	1.00	cu. yd.	1.50	cu. yd.
Springfield	1.00	cu. yd.	1.25	cu. yd.	3.50	cu. yd.
Virginia:						
Charlottesville	1.50	yd.	....	.....	2.30	yd. or ton
Danville	.60	yd.	....	.....	3.50	cu. yd.
Fredericksburg	1.00	cu. yd.	2.00	cu. yd.	....	.....
Newport News	2.00	cu. yd.	2.50	ton	3.10	ton
Norfolk	1.40	ton	2.40	ton	3.00	ton
Petersburg	.75	ton	1.25	ton	3.50	ton
Pulaski	2.00	cu. yd.	....	.....	2.50	cu. yd.
Salem	2.00	cu. yd.	2.00	cu. yd.	3.65	cu. yd.
Suffolk	1.90	ton	2.40	ton	....	.....
Washington:						
Bellingham	2.50	cu. yd.	2.50	cu. yd.	....	.....
Chehalis	1.90	cu. yd.	1.90	cu. yd.	2.25	cu. yd.
Dayton	2.70	cu. yd.	1.20	cu. yd.	1.90	cu. yd.
Okanogan	1.00	cu. yd.	1.75	yd.	2.00	yd.
Puyallup	2.75	cu. yd.	2.25	cu. yd.	....	.....
Raymond	3.70	cu. yd.	3.70	cu. yd.	....	.....
Seattle	1.75-2.25	cu. yd.	1.75-2.25	cu. yd.	....	.....
W. Virginia:						
Bluefield	3.50	cu. yd.	3.50	cu. yd.	3.50	cu. yd.
Fairmont	3.00	ton	3.50	ton	....	.....
Parkesburg	2.00	cu. yd.	2.00	cu. yd.	3.00	ton
Wheeling	1.40	ton	1.20	ton	....	.....
Wisconsin:						
Appleton	1.85	ton	1.50	cu. yd.	2.60	ton
Delavan	3.00	cu. yd.	2.60	ton	....	.....
De Pere	1.25	yd.	2.50	yd.	2.50	yd.
Fond du Lac	2.75	yd.	2.80	.....	3.00	.....
Green Bay	2.50	cu. yd.	3.00	cu. yd.	3.25	cu. yd.
Kaukauna	2.75	cu. yd.	2.50	ton	2.50	cu. yd.
Lake Geneva	1.50	yd.	1.25	yd.	2.00	yd.
Madison	1.90	ton	2.15	ton	....	.....
Manitowoc	....	.....	1.55	ton	1.55	ton
Marshfield	3.50	cu. yd.	4.60	cu. yd.	4.90	cu. yd.
Milwaukee	2.10	ton	2.40	ton	2.40	ton
Oshkosh	2.00	cu. yd.	2.40	cu. yd.	2.40	cu. yd.
Sheboygan	1.50	ton	1.50	ton	1.40	ton
Superior	1.25	cu. yd.	1.75	cu. yd.	2.00	ton
Waukesha	1.50	yd.	1.60	ton	1.60	ton
Wausau	2.00	cu. yd.	2.00	cu. yd.	3.50	cu. yd.
Wisconsin Rapids	2.37	cu. yd.	2.98	cu. yd.	3.50	cu. yd.
Wyoming:						
Casper	....	.....	2.00-2.50	yd.	....	.....
Sheridan	2.50	yd.	2.50	yd.	2.50	yd.

Table No. 3—Methods of Paying for Paving

Name of City	Percentage of Paving Cost: Assessed on abutting property.	Percentage of Paving Cost: Paid in city.	Method of Calculating Assessments	Payable in how many instalments.	Funds obtained by city by	Life of bonds, years.
Alabama:						
Bessemer	.....	⅓	By front foot.	10	bonds	10
Fairfield	all	.....	By front foot.	10	.....	10
Gadsden	all	.....	By front foot, inersectlons by city.	10	bonds	10
Montgomery	all	.....	By front foot, intersections by property owners.	10 & 20	bonds	10 & 20
Selma	all	.....	By front foot.	10	bonds	10
Troy	⅔	⅓	By front foot.	10	bonds	10
Arizona:						
Globe	.....	33%	By front foot, intersections by city.	10	budget	10
Tucson	all	.....	By front foot, excl. intersections.	10	budget	10
Arkansas:						
De Queen	.....	all	By cubic yard.	..	annual budget	..
Fayetteville	.....	.....	50% assessed value, 50% front ft.	1	city warrants	10
Helena	75%	25%	Benefits—front foot.	10-20	budget	10-20
Little Rock	all	.....	By front foot.	10	.....	..
Pine Bluff	all	.....	By front foot, incl. intersections.	..	.....	..
California:						
Alameda	all	special cases	By area.	..	budget	..
Calexico	all	.....	Various methods.	10	budget or bonds	10
Eureka	all	.....	By paving districts, incl. intersections.	9 or 14	annual budget	..
Los Angeles	all	.....	By front foot.	10	.....	..
Napa	asph. mac. 100% conc., 65%	35%	By front foot, intersections by property owners.	5	annual budget	..
Palo Alto	all	.....	By front foot.	cash	annual budget	..
Porterville	all	.....	By front foot, area of lot.	10	budget	10
Redlands	all	.....	.....	10	.....	10
San Bernardino	all	.....	By front foot, incl. intersections.	9	.....	10
San Francisco	all	.....	Front ft. or sq. ft. on special projects.	10	budget	10
Santa Maria	.....	.....	By assessment districts, intersections included.	1	budget	..
So. Pasadena	all	.....	Area (district plan).	10	.....	10
Vallejo	all	.....	Front foot and area.	10	.....	9
Whittier	all	.....	Front foot.	10	.....	10
Colorado:						
Boulder	all	.....	(See note.)	15	.....	15
Longmont	all	.....	By front foot, excl. intersections.	10	budget	10
Pueblo	all	.....	(See note.)	2	bonds	20
Trinidad	all	.....	By front foot, intersections to 4 half blocks.	20	bonds	20
Connecticut:						
Bristol	⅓	⅔	By value of lot.	2	budget	..
Hartford	½	½	By front foot.	1	budget	..
Manchester	.....	all	.....	..	.....	..
Meriden	½	½	By front ft., intersections by city.	3	bonds	partial maturity each year.
New Britain	all	.....	By front foot.	1	budget	..
New Haven	.....	.....	Flat rate per front ft. (see note).	2	bonds	20
Norwich	.....	all	.....	..	bond	30
Putnam	.....	all	.....	..	budget & notes	..
Rockville	⅔	⅓	Only on sidewalks—as taxes.	..	budget	..
Stratford	.....	.....	.....	..	budget	..
Willimantic	.....	.....	.....	..	budget	..
Florida:						
Fort Lauerdale	all	.....	By front ft., intersections by city.	1-10	bonds	20
Fort Myers	9/10	1/10	Area, intersections by city.	5	bonds	5
Gainesville	⅔	⅓	Front ft., incl. intersections.	3	bonds	25-30
Sanford	⅔	⅓	By front foot.	1-10	bonds & budget	30
St. Augustine	⅔	⅓	By front foot.	30 days after is complete.	.....	..
St. Petersburg	all	.....	By front ft., incl. intersections.	5	.....	..
Georgia:						
Athens	¼	¾	Front foot.	1	bonds	30
Columbus	⅔	⅓	By front ft., intersections by city.	1	both	30
Griffin	⅔	⅓	Front ft., intersections pro-rated.	5	bonds	5-6
Rome	⅔	⅓	By front foot.	4	budget	..
Idaho:						
Boise	all	.....	By front ft., intersections by city.	10	bonds or budget	10
Illinois:						
Beardstown	all	.....	By front ft., intersections by city.	10	bonds	10
Benton	all	.....	By front ft., intersections pro-rated.	10	.....	10
Bloomington	all	.....	Benefits on front ft. basis, intersections by city.	10	budget	10
Canton	75%	25%	By front foot.	10	budget & bonds	10
Centralia	all	.....	Special benefits.	10	.....	10
Champaign	all	.....	(See note.)	10	budget	2-10
Chicago	all	none	By front ft.; or for ½ block each side of street. (See notes.)	..	.....	..
Chicago Heights	all	.....	By area of pavement.	10	budget	..
Collinsville	.....	.....	Front foot.	..	.....	..
Danville	.....	.....	Unusually front foot.	10	budget	10
Edwardsville	95%	5%	Front ft. mostly—area partly.	10-5	item for permanent impvs.	10-5
East Mollne	all	.....	Front ft., with exceptions in regard to benefits.	7-10	.....	7-10
Evanston	all	.....	By front foot.	1-10	.....	..
Galena	.....	.....	Varied—by front foot.	10	cash—bonds	10
Jacksonville	all	.....	By front ft. Special tax.	10	sometimes public benefit tax.	10
Joliet	95%	5%	Front foot.	10	budget	2-10
Kewanee	90%	10%	By front ft. of lots for 90% of total cost.	10	bonds—special assessment.	1-10
La Grange	all	.....	Front foot.	10	.....	..
Litchfield	all	.....	Front foot.	10	.....	..

To be continued

NEWS OF THE SOCIETIES

CALENDAR

Feb. 20-23—NATIONAL ASSOCIATION OF BUILDERS' EXCHANGES. Annual meeting. Hotel Chisca, Memphis, Tenn.

Feb. 20-23—AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS. Engineering Societies Bldg., New York City. Secretary, F. F. Sharpless, 29 W. 39th st., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23—MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention. Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN ASSOCIATION OF ENGINEERS. Conference of practicing engineers. Congress Hotel, Chicago.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Feb. 24-25—ENGINEERING SOCIETY OF WISCONSIN. Annual meeting. Madison. Secretary—L. E. Smith, Madison.

Mar. 14-16—AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual convention. Chicago, Ill.

Mar. 15—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Mar. 18—ROCHESTER ENGINEERING SOCIETY. Quarter-centennial dinner.

Mar. 23-24—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting. Urbana, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

SOCIETY OF INDUSTRIAL ENGINEERS

The Society of Industrial Engineers held a meeting on February 14th at the Auditorium Hotel, Chicago. This was the second meeting in the Chicago chapter series on "Stabilization of Industry," and the subject was "The Wastes of Uneven Production." Addresses by a general manager, a works manager or industrial engineer, and a labor leader or economist.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

The 125th meeting of the American Institute of Mining and Metallurgical Engineers was held at the Engineering Societies Building, New York City, on February 20-23. This included sessions on Mining Methods, Industrial Relations, Safety, Non-Metallic, Iron and Steel, and Mining, also meetings of Institute of Metals division. The social features of the meeting consisted of the annual banquet, special excursions and entertainments.

PRACTICING ENGINEERS

The First Annual Conference of Practicing Engineers will be held at Congress Hotel, Chicago, February Twenty-second, 1922, under direction of Committee on Services and Fees for Practicing Engineers, American Association of Engineers.

The purpose of this conference is to discuss problems of service, fees, office procedure, professional relations and business methods to promote more uniform practice in the profession, higher ethical standards, and a better understanding among practicing engineers of the common problems peculiar to their work and to their relation with the public. Ample time will be provided for a full discussion of the papers presented.

The conference is open to all practicing engineers in every branch of the profession. A particular invitation is extended to mechanical, electrical and chemical engineers. Registration will begin at 9:00 a. m. Wednesday, February 22nd, in the Green Room of the Congress Hotel.

Program: "Publicity for Practicing Engineers," M. W. Lee; "How to Uphold the Standards of Services and Fees," Gardner S. Williams; "Experiences of the Practicing Engineer with Licensing," C. S. Hammatt; "How to Sell Engineering Services," Paul E. Green; "Cost Accounting for Engineering Services," Arthur L. Mullergren; "Computing the Practicing Engineer's Income Tax," Clarence W. Hubbell.

TOUR OF PRESIDENT COOLEY

President Cooley has arranged the following tour in the interests of the Federated American Engineering Societies: Feb. 6-10, Engineers' Club of Kansas City, Mo., University of Kansas, Kansas Engineering Society, Oklahoma City engineers, Oklahoma University at Norman; February 15, Southern Methodist University and the Technical Club of Dallas, University of Texas and the Engineering Faculty of the University; February 16, Agricultural and Mechanical College of Texas; February 17, Houston Engineers' Club; February 20, Louisiana Engineering Society and Tulane University, and the State University at Baton Rouge; February 25, the Affiliated Technical Societies of the City of Atlanta; March 1, Georgia School of Technology at Athens; March 3, Alabama Technical Association in Birmingham; March 6, Engineers' Association of Nashville, and March 7, Architects' Club of Louisville and Lexington University.

IDAHO ENGINEERS AND ARCHITECTS MEET

Three organizations of technical men of Idaho—the Idaho Society of Architects, the Idaho chapter of the A.A.E. and the Idaho Irrigation Congress—met in joint session on January 16-21 at Rupert. The relation of architecture to engineering, city planning, the state building code, the unemployment situation, utilities valuation, government regulation of railroads, mining engineering methods and a review of the value and extent of the phosphate resources of Idaho were the main topics of discussion. Irrigation bills were endorsed.

Officers elected to head the A.A.E. were as follows: president, E. E. Moberly; vice-presidents, J. E. Wilson and S. T. Baer; secretary-treasurer, E. F. Ayers.

MISSISSIPPI VALLEY OFFICIALS HIGHWAY ASSOCIATION

At the meeting of the Mississippi Valley Officials Highway Association at Decatur, Ill., on January 22nd, F. R. White, of Ames, Iowa, was elected president and M. W. Watson of Topeka, Kans., secretary.

ENGINEERS' CLUB OF MINNEAPOLIS

Walter H. Wheeler, consulting engineer of Minneapolis, was elected president of this club, W. P. Ryan of the department of engineering, University of Minnesota, was elected vice president; A. F. Mellen was chosen secretary and O. F. Moore, treasurer.

TOPEKA ENGINEERS CLUB

The annual meeting and banquet of the Topeka Engineers' Club was held on January 24th. Officers were elected for 1922 as follows: President, A. B. Griggs; first vice-president, Ray Finney; secretary, W. L. Lammers and treasurer, C. A. Funchess.

ENGINEERING SOCIETY OF BUFFALO

A meeting of the Engineering Society of Buffalo was held at the Iroquois Hotel, Buffalo, on February 14th which was addressed by Ralph H. McKee, professor of chemical engineering, Columbia University, on "Gasoline from Oil Shale."

MOHAWK VALLEY ENGINEERS' CLUB

A meeting of the Mohawk Valley Engineers' Club was held on February 2nd, which was addressed by Calvin W. Rice, secretary of the American Society of Mechanical Engineers; by B. R. Cummings, engineer of the radio department, General Electric Company, who demonstrated by actual working apparatus in receiving and sending wireless phone messages the principles of the wireless; and by Mr. O'Connor of the J. & M. Electric Company.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

THE AULTMAN TAYLOR COMPANY'S TRUSTY TRACTOR

ROAD BUILDING TRACTORS

The kerosene and gasoline tractors, manufactured by the Aultman-Taylor Machinery Co., are designed for hauling road making and maintaining machinery, and are built in three sizes, the Faithful, which will handle an 8-foot blade grader, the Sturdy to haul a 10 or 12-foot grader and the Trusty for the heaviest service, including the simultaneous hauling of two 12-foot blade graders. They are all equipped with 4-cylinder engines and at normal motor speed have road speeds varying from 2.13 to 2.93 miles per hour. They are strong and durable and some of them have been in use for 10 years and are still serviceable and satisfactory. The machines have been purchased by more than 500 townships in 17 states and in Canada.

The makers claim that the use of tractors save from 50 to 75 per cent. of road building cost and build double the number of miles in the same length of time and build them better. In support of these claims a number of testimonials are published, making various statements concerning the efficiency and economy of the work. In Schuyler, Nebraska, a tractor hauling a 12-foot blade grader used 55 gallons of gasoline and 4 gallons of lubricating oil in 14 hours. A tractor in Seward County, Nebraska, graded 35½ miles of road at an average total cost of $35.00 per mile. In Newhall, Iowa, a Trusty tractor uses about 40 gallons of kerosene and 5 gallons of gasoline per 10-hour day, pulling a 12-foot Adams grader.

In Oskaloosa, Kansas, the tractor averaged 1¼ miles per day, using 25 gallons of gasoline and 3½ gallons of oil in 10 hours and doing work at an estimated cost of from 1/3 to 1/10 of the cost of the same work done with teams. In one case a mile of road, involving considerable gumbo, was built in one afternoon under circumstances where more than 20 good teams would have been required without the tractor.

THE WINNER HIGHWAY PATROL

This machine has interchangeable and malleable iron parts strong enough to endure the strain from a small tractor, although intended for service as a two-horse grader. The wheels have concave treads to prevent slipping and the hubs are fitted with dust-proof boxes and oil cups.

The adjustments are simple, quick and powerful, and are easily made by the operator without changing his position.

The blade is raised and lowered by means of hand wheels operating in connection with a worm and gear mechanism. By simply releasing a bolt held in place with a spring, the blade can be reversed to any angle, or all the way round. The blade when set to an angle of 45 degrees, can be shifted laterally two feet outside the line of the wheels. This lateral shift is controlled by means of a screw and bevel gearing. By simply removing three bolts the blade can be inclined backward and forward to suit the varying conditions of the soil.

In any kind of work, such as plowing, cutting down banks, or moving earth, the machine can be operated by one man and two horses, thus building and maintaining a road at a very low cost.

The machine has a 6-foot blade, 8-foot wheelbase, 35 degree range of tilt adjustment, 16-inch vertical adjustment, and weighs 1,150 pounds. It is manufactured by the Good Roads' Machinery Co., Inc.

PERSONALS

Craven, Walter S., has been appointed city engineer of Ogden, Utah.

Jackson, William T., has been appointed director of public service of Toledo, Ohio.

Hill, Robert Clark, acting county engineer of Sussex County, Del., has been elected engineer for 1922.

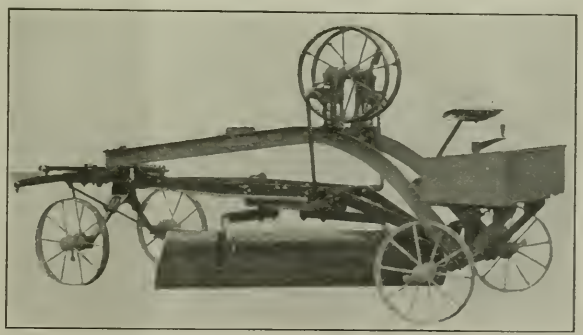
Roberts, Arthur B., of Cleveland, Ohio, has been appointed director of public works by Mayor Kohler.

Earle, David M., city engineer of Worcester, Mass., has been reappointed by the common council.

Halcott, George C., who for many years has been superintendent of public buildings of Worcester, Mass., has been re-elected by the common council.

Davis, B. H., city engineer of Iowa City, Ia., has been reappointed for one year.

Gibbony, Frank L., formerly city engineer of Roanoke, Va., died recently in Charlotte, N. C.



GOOD ROADS MACHINERY CO'S WINNER HIGHWAY PATROL

INDUSTRIAL NOTES

The Dayton-Dowd Co. of Quincy, Ill., has opened a district office at Pittsburgh, Pa., at 809 Keenan Bldg., covering the sale of that company's centrifugal pumps and underwriters' pumps. This office will be in charge of T. J. Barry, who for the past several years has been connected with the home office of the company.

The Milwaukee Tank Works, Milwaukee, Wis., has opened a branch factory at San Francisco, Cal., to expedite the shipment of the company's equipment to the Pacific coast states. Mr. R. W. Johnstone is manager of the branch.

The Bucyrus Co., South Milwaukee, Wis., announces the appointment of A. R. Hance as sales manager with the Northwestern sales office of this company at 608 Pittock Block, Portland, Ore., to succeed L. T. Russell, who resigned after ten years' service.

The Parsons Co., manufacturers of trench excavating machinery, has established a branch office at 510 Railway Exchange Bldg., Kansas City, Mo., with J. E. Demuth as district manager in charge of the office. Agencies have also been established with Fred S. Sawyer, 2220 Market street, Philadelphia, Pa., and with F. S. Truex, manager of the Atlanta Machinery Co., Atlanta, Ga.

D. B. Frisbie of Atlanta, Ga., has been given the responsibility of developing a large selling organization throughout the south for the Barber-Greene Co., of Aurora, Ill. The following southern sales organizations are under his direction: General Utilities Co., Norfolk, Va.; Standard Equipment and Machinery Co., Spartanburg, S. C.; A. B. Moore, Jr., Savannah, Ga.; Alabama Machinery & Supply Co., Montgomery, Ala.; J. D. Turner Co., Birmingham, Ala.; Wilson, Weesner & Co., Nashville, Tenn.; Dealers Coal Mining Co., Nashville, Tenn.; E. W. Price, Tampa, Fla.; Higgins & Wormington, New Orleans, La., A. M. Lockett Co., New Orleans,

CHANGES OF WESTINGHOUSE ELECTRIC PERSONNEL

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces that T. H. Hayes has been appointed manager of the Indianapolis, Indiana, office of the company. A. E. Hitchner, assistant to the manager, industrial department, in general charge of the mining and electro-chemical industries, will have general charge of the sections, formerly handled by W. H. Patterson, who recently resigned as assistant to the manager of the industrial department to accept the position of vice president of the Kaestner & Hecht Company, Chicago, elevator manufacturers, who handle Westinghouse direct traction elevator equipment in the Middle West.

HOLT ROAD TRACTOR EXHIBIT

At the National Good Roads Show in Chicago, January 17-20, the exhibit of The Holt Manufacturing Co. represented the manner in which "Caterpillar" tractors with especially designed equipment eliminates horses and mules in road work. The Holt exhibit, occupying 2,000 square feet in the main building, comprised a complete line of "Caterpillars." A 10-ton, with left-hand drive, was hitched to the largest sized Russell Elevating Grader, and alongside of it was a 5-ton hitched to a six-yard La-Plant-Choate Dump Wagon, representing a complete unit in a motorized outfit. Visitors at the show had a visual demonstration of this new method by means of the "Caterpillar" motion pictures which were constantly shown on a large elevated screen at the end of the Holt exhibit.

One the 5-ton was also mounted a "Caterpillar" bulldozer, used for filling in and leveling on the dump, and as a snow plow.

Another 10-ton was hitched to a big 12-foot Adams' Road King Grader, and motion pictures were shown of this combination outfit at work in Bureau County, Illinois. A 5-ton was shown hitched to a Baker Maney Self-loading Scraper. The T-35, the smallest number of the "Caterpillar" line is especially designed for road dragging, patrol maintenance, industrial and road making operations of many kinds.

Numerous officials and representatives of The Holt Manufacturing Co. were in attendance during the show, including M. M. Baker, vice president. Numerous orders were placed for tractors, and other Holt products.

CLEVELAND BUILDING EXPOSITION POSTPONED

The opening of The American Building Exposition, Cleveland, has been postponed from February 22 to a date in April, probably not later than the 18, to correspond with the delayed completion of the new city auditorium before it is formally accepted by the city and offered for exhibition purposes. This is the second postponement that has been forced upon the Exposition management through failure to have the building finished upon schedule time. Originally it was scheduled to open on January 4. The largest of the individual exhibits will represent an outlay of approximately $25,000.

The Exposition, sponsored by The Builders' Exchange, is being put on upon a co-operative, non-profit basis, the net profits to be rebated pro rata to the exhibitors, the sole object being to stimulate building interest in the Cleveland district.

PERSONALS

Ure, F. J., town engineer of Woodstock, Ont., has been appointed engineer and surveyor for East Zorra township.

Ferris, W. H., has been appointed chairman of the highway committee of the Essex County Council, Ont.

Sutherland, Dr. W. H., has been appointed Minister of Public Works for British Columbia.

Young, Samuel, has been appointed chief engineer of the Board of Commissioners of the Port of New Orleans, La.

Starr, Rex C., has been named chief engineer for the Merced Irrigation District.

Ragland, R. F., formerly assistant engineer in charge of road maintenance and construction in Yellowstone National Park, is now connected with the state highway commission of Montana.

Bestor, O. B., has been appointed principal locating engineer for the North Carolina State Highway Commission.

Wiggin, Thomas H., formerly principal designing engineer of the Catskill aqueduct for the Board of Water Supply of New York City, has opened an office in New York City for the practice of engineering.

Lackey, O. B., has been made city manager of Morganton, N. C.

Frost, Harry, superintendent of the waterworks department of Akron, Ohio, died on January 27th.

Tewksbury, E. A., has been appointed acting city engineer of Cuyahoga Falls, Ohio.

Campbell, P. F., was elected borough engineer of Lilly, Pa., at a recent meeting of the council.

Kennedy, John P., has been appointed a member of the board of public utilities of Los Angeles, Cal.

Fitzpatrick, Patrick H., has been appointed superintendent of streets for the city of Bridgeport, Conn., for a term of two years.

Hinkle, Henry Gordon, for four years city manager of Altoona, Pa., has been appointed city manager and chief engineer of Columbus, Ga.

Borden, George W., acting chief since the resignation of C. C. Cottrell last September, has been made chief engineer of the department of highways for the state of Nevada.

Bailey, A. R., has been appointed engineer manager of the Washtenau County, Mich., road commission, to succeed John J. Cox, resigned.

Wheatley, Charles, of the Georgia state highway department, has been made city engineer of Americus, Ga.

LaFleur, Eugene D., chief engineer of the Canadian department of public works, died suddenly at his home at Ottawa.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 FEBRUARY 25, 1922 No. 8

Scoring Water and Sewage Treatment Works

By Francis E. Daniels*

A suggested system of scoring water purification and sewage treatment plants whereby comparisons can be made of different plants or of different periods of operation of the same plant

For the past fourteen years the writer has been actively engaged in making inspections of water purification plants and sewage treatment works, and during that time he has on ever so many occasions been asked how a plant stands as compared with the other plants of the state. Quite frequently state health officials want to know the relative standing of the various water and sewage works and in some states it is required to be shown at monthly intervals whether or not such works are satisfactory. To have but the two grades, satisfactory and unsatisfactory, leaves too much unsaid, invites argument, puts too much on the general judgment of the inspector, and frequently results in misunderstanding and ill feeling. Hardly any difficulty would arise in cases of very excellent or hopelessly bad plants; but with the great majority of works, which are neither perfect nor yet blameworthy, unless certain rules or methods of analyzing are employed to limit as much as possible the personal equation of the men, no two inspectors will pass alike on the same plant. They still might agree that the plant is satisfactory or unsatisfactory because, although not wishing to place it in one category, they are unwilling on general grounds to have it in the other. They simply choose the lesser evil. The inspector in many cases, then, has either to put practically all his plants down as unsatisfactory, which looks decidedly bad, or else he stultifies himself in trying to have minor improvements made on plants which he and his department have set down as satisfactory.

To remedy the above and to endeavor to devise a system of scoring whereby a graded list of water purification plants and a similar list of sewage treatment works could be made, about two years ago the writer drew up tentative score cards for this purpose.

The rough drafts of each were submitted to the chief engineers of several states for criticisms and suggestions. Many helpful suggestions were received and another set was made. These forms, while far from perfect, perhaps, are here given to suggest possibilities, and it is hoped that they will prove useful as a basis upon which to build a system of scoring so that different inspectors can arrive at a proper relative grading of their works for comparisons in their own state as well as with other states adopting the same system.

Having obtained a true graded list, with each plant accompanied by its percent, it then only becomes necessary to divide the list according to rating into groups, such as excellent, good, fair, unsatisfactory or blameworthy.

It is believed that a duplicate copy, made at the time of inspection, should be left with the superintendent of the plant or forwarded promptly to the one in responsible charge. This will show in detail how the rating was computed and exactly what should be corrected in order to raise the standing. It will further promote rivalry if the monthly list of standing is sent to those in responsible charge of every plant. It is believed that incentive will be given to procure additional apparatus and to keep in better order and operation the equipment already in use.

By the use of small type and closely ruled lines, the whole card can be printed on a single sheet and still have ample room to place the score numbers with a pen or hard pencil. The sheets are put up in tablet form and registered so that a sheet of carbon paper my be placed between two successive pages to make an accurate copy at the time the original is made. One page is kept by the inspector and the other passed on to the local authority if such is allowed. This the writer would recommend, although some state authorities do not consider it good policy to do so.

*Assistant Engineer, Penna. Dept. of Health.

STATE OF .....

DEPARTMENT OF HEALTH—DIVISION OF ENGINEERING
Water Purification Plants
Score Card

Name of Plant..... Rating .....

Location ..... Borough } ..... County .....
Township }

Inspected by..... Date.....

Equipment		Perfect Score	Allowed
Source of Supply (3)			
Pollution constant	0		
Pollution casual	3		
Pump Station (8)			
Raw water pumps—			
Capacity	2		
Condition	2		
Filtered water pumps—			
Capacity	2		
Condition	2		
Sedimentation Basin (4)			
Capacity	4		
Filter Units (18)			
Depth of gravel	2		
Depth of sand	2		
Size of sand	1		
Dist. of sand below trough	1		
Sand agitation	2		
Sufficiency of wash water	4		
Rate of filtration	1		
Rate controllers	2		
Rate of flow recorder	2		
Loss of head gauges	1		
Clear Water Basin (1)			
Capacity and protection	1		
Coag. Apparatus (2)			
Equipment and point of application of chemical	2		
Alk. Apparatus (2)			
Equipment and point of application of chemical	2		
Disinfecting Apparatus (5)			
In duplicate	3		
Adequate	2		
Storage Reservoir (2)			
Adequacy and protection	2		
Laboratory Control (5)			
Turbidity	1		
Color	.5		
Alkalinity	1		
CO_2	.25		
Plating	.5		
Fermentation	.5		
Free chlorine	.25		
Sum			

Operation		Perfect Score	Allowed
Source of Supply (2)			
Patrol or other means to control pollution	2		
Intake (1)			
Conditions around	1		
Pump Station (4)			
Raw water pumps—			
Operation and attention	2		
Filtered water pumps—			
Operation and attention	2		
Sedimentation Basin (3)			
Condition	3		
Filter Units (20)			
Condition of gravel and strainers	3		
Condition of sand	5		
Character of sand agitation	2		
Efficiency of wash	3		
Frequency of wash	1		
Proper control of rate	3		
Condition of rate controllers	2		
Condition of loss of head gauges	1		
Clear Water Basin (1)			
Condition of	1		
Coag. apparatus (2)			
Operation	2		
Alk. Apparatus (2)			
Operation	2		
Disinfecting Apparatus (5)			
Operation and proper dose	5		
Storage Reservoir (2)			
Condition	2		
Laboratory Control (5)			
Turbidity	}		
Color	.5		
Alkalinity	1		
CO_2	.25		
Plating	.5		
Fermentation	.5		
Free chlorine	.25		
General condition in and around plant as to cleanliness and appearance not included in the above	3		
Sum			

Equipment Score .....

Operation Score .....

Total Score .....

Sufficiency of Treatment (including cond. of permit).....
(Department requirements)

Corrected Score .....

Sum allowed x 50 / Sum perfect = Score

Penalties .....

Minimum Satisfactory Rating = 75

Final Rating .....

Penalties: for using bypass, —10 to — 100; for no coagulant, —10 to — 50; for no disinfectant, —50 to 100; for any gross carelessness or neglect, —50 to —100.

SEWAGE TREATMENT PLANTS SCORE CARD

Name of Plant.....Rating .....

Location .....Borough / Township.....County .....

Inspected by .....Date.....

Weather for 24 hours.....

Equipment	Perfect Score	Allowed
Grease Traps (2)		
Type and adequacy	2	
Grit Chamber (1)		
Adequacy	1	
Screens (2)		
Type	1	
Construction	1	
Fine Screens (6)		
Type	3	
Construction	3	
Sett. or Septic Tanks (6)		
Capacity	3	
Character	3	
Imhoff Tanks (6)		
(Settling and Digesting)—		
Adequacy	3	
Construction	3	
Contact Beds (6)		
Adequacy and materials	2	
Dosing apparatus	2	
Discharge apparatus	2	
Trickling Filters (6)		
Adequacy	1.5	
Materials	1	
Dosing apparatus	1	
Distrib. apparatus	1	
Efficiency of distrib.	1.5	
Sand Filters (6)		
Adequacy	1.5	
Materials	1.5	
Underdrainage	1.5	
Dosing	1.5	
Chemical Treatment (4)		
Adequacy	2	
Character of appliances	2	
Final Settling Tank (1)		
Adequacy and materials	1	
Sludge Bed (3)		
Adequacy and construction	3	
Broad Irrigation (4)		
Adequacy	4	
Sub-Surface Irrigation (4)		
Adequacy	4	
Pump Station (2)		
Adequacy and general installation	2	
Tests and Analyses	1	
Sum		

Operation	Perfect Score	Allowed
Grease Traps (2)		
Care	2	
Grit Chamber (1)		
Care	1	
Screens (2)		
Care	1	
Disposal of screenings	1	
Fine Screens (6)		
Care	3	
Disposal of screenings	3	
Sett. or Septic Tanks (6)		
Care	3	
Character of effluent	3	
Imhoff Tanks (6)		
Care	1	
Conditions in gas vent	1	
Conditions in flow comp.	1	
Conditions in sludge comp.	1	
Character of effluent	2	
Contact Beds (6)		
Care	1.5	
Condition of dosing app.	1.5	
Condition of discharge app.	1.5	
Condition of beds	1.5	
Trickling Filters (6)		
Care	1.5	
Condition of materials	1	
Condition of disb. app.	1	
Condition of underdrains and channels	1	
Condition of effluent	1.5	
Sand Filters (6)		
Care	1.5	
Condition of sand	1.5	
Condition of underdrains	1.5	
Condition of effluent	1.5	
Chemical Treatment (4)		
Care	2	
Efficiency	2	
Final Settling Tank (1)		
Care and condition	1	
Sludge Bed (3)		
Care	1	
Character of sludge	1.5	
Disposition of sludge	.5	
Final Effluent (5)		
General character	5	
Broad Irrigation Field (4)		
Care and condition	4	
Sub-surface Irrigation (4)		
Care and condition	4	
Pump Station (2)		
Care and general conditions	2	
Tests and Analyses	1	
General conditions in and around the plant as to cleanliness and appearance not included in the above	3	
Sum		

Equipment Score .....

Operation Score.....

Total Score.....

Sufficiency of Treatment (including cond. of permit).....
(Department requirements)

Sum allowed x 50 / Sum perfect = Score

Minimum Satisfactory Rating = 75

Corrected Score .....

Penalties .....

Final Rating .....

In the sample sheets shown, the figures placed opposite the various items are the values of such items if perfectly satisfactory. They are only suggestive and could be changed to meet the judgment of any board appointed to pass upon and adopt the system. Once having been adopted, they would then remain.

The manner of filling in the blanks is as follows:

The headlines are filled in as indicated, except that the space marked "Rating" is held open until the final rating is computed from the details, when it is transferred to the top for purposes of easy view and tabulation.

Then each item is considered and, if it applies to the plant under observation, the perfect figure for it is transferred on the same line into the column marked "Perfect Score" and after careful consideration a figure is placed opposite in the column "Allowed" which, in the judgment of the inspector, is a fair mark for that item, which may be anywhere from 0 to the perfect mark indicated.

If the item does not apply to the case under consideration, such as pumps at a gravity plant, septic tanks at an Imhoff tank plant or something similar, then it is not considered and both columns are blank on that line. But on the other hand if the apparatus is required although it has not been installed, then the perfect mark is placed in the "Perfect" column and a zero in the "Allowed" column.

So on for all the items in both the equipment list and operation list in detail.

Then both columns in each list are added up, the sums in each case showing, respectively, what would have been received had all been perfect and what was really allowed in the inspector's judgment.

Since in this case the equipment and operation are both weighted equally, the sum "Allowed" multiplied by 50 and divided by the sum of the "Perfect" will equal the equipment score and operation score, respectively, in each list and the sum of the two scores will give the total score of the plant.

Now comes a most important factor. A competent board must pass upon every plant in the state and give each a factor which will be the leveling stick to put all the plants on a relative basis.

This will be known as the "sufficiency of treatment" factor, and depends entirely upon local conditions and requirements.

Some conditions require a large equipment and a high degree of treatment while others need very little. For example, a plant may be quite elaborate, having pumps, filters, and many other accessories, but really only half equipped for the vital conditions, while another plant might not possess either pump or filters but be amply equipped for all needs and emergencies under conditions at that place. The first would be rated as a 50 per cent plant while the second would be 100 per cent. Therefore, if any plant is wholly up to all that can reasonbly be expected in both equipment and operation for all local conditions, then that plant should receive a high rating in the relative list of the state.

The inspector then takes his sufficiency of treatment factor from the official list of the department and multiplies the total score by it. This gives him the corrected score.

Now, if there is detected any neglect, gross carelessness or other similar shortcoming, then there is subtracted from the corrected score the value of such as indicated by the table of penalties. This gives the final rating, which is transferred to the top of the sheet for ready reference.

The plants of the whole state are then listed in the order of their standing and so published with the rating of each shown. Appropriate groupings may be made as above mentioned, giving special notice that those below a certain percent, say 75, are unsatisfactory and should be improved as indicated on the detailed score card.

It will be noted that although water purification plants and sewage treatment works are treated separately, the above remarks apply equally well to the two kinds of score cards.

It seems to the writer that this system is not unlike the systems of grading recitations and examinations in successful use at many of our colleges. It should be a considerable help in training new inspectors to be critical and searching in their visits, and to record accurately in brief detail essential features.

It should be most valuable in showing to all concerned exactly the good and bad items and how the scores and final ratings are derived, with the errors due to personal equation eliminated as far as possible.

Finally, the writer offers the scheme with the hope that it be put to use as it is, or with any changes or additional features which may make for improvement.

State Highway Traveling Bridge Camp

Among the $3,000,000 worth of the war department's supplies allotted to the highway department of North Carolina, there were included 500 motor trucks, more than 100 touring cars, and a number of trailers intended to be hauled by trucks for transporting supplies and munitions to the front. Some of this equipment has been ingeniously modified at small cost for the construction of several peripatetic bridge construction and maintenance camps, that have proved to be very convenient and satisfactory. They afford comfortable quarters for the men, who are thus secured of a better grade than can be retained when the living conditions are disagreeable, and provide for their simultaneous transportation and that of all their regular equipment.

A standard camp consists of the hauling truck, sleeping car, dining and kitchen car, and tool car. The hauling truck is a 3-ton army standardized B, heavy cargo truck, unchanged except by the addition of side supports for carrying painting scaffolds. The truck has a high rounded canvas cover and its body is used for the storage and transportation of heavy tools, rope and other bulky equipment.

The sleeping car has a body similar in appearance to that of a small railroad box car, built on the chassis of a trailer. It has three small windows on the long side and a door in each end and is equipped with four double deck steel bunks, one in each corner with a wood stove in the center, affording

very comfortable, well ventilated quarters for the eight men comprising the regular bridge gang. The car is 8 feet wide and 17 1-2 feet long.

The kitchen and dining car has the same dimensions and general exterior appearance, except that one of the side windows is replaced by a door and that there is only one end door. At the forward end of the car there are folding wall tables, with shelves above them for the storage of supplies. At the opposite end of the car is the kitchen, with stove, dishes, cooking utensils and other necessaries. The stove is provided with an extension pipe projecting through the roof of the car and lowered when the car is in transit. Both the dining and sleeping cars were built on the chassis of 3-ton trailers, unchanged except by the addition of a drawbar in the couplings to provide for the overhang of the body.

In the rear of the dining car is the small tool car modified with but little change from the chassis of a 1 1-2-ton army cargo trailer combined with the body of an army combat wagon. The workmanship, fittings and finish of all the cars are excellent and the changes made to prepare them for the highway service cost only about $250 per car.

The North Carolina Highway Department has also utilized ambulances for survey cars, aeroplane hangars for truck sheds, and the semi-cylindrical steel roofs of bomb proof shelters mounted on walls and floors for the storage of several thousand pounds of T. N. T. and black powder received from the government.

Where the Good Roads Dollar Goes

By J. E. Pennybacker*

Analysis of costs of over three thousand miles of Federal aid roads completed by June, 1921

Out of each dollar spent to build good roads, labor at the job gets an average of 42 cents; the engineers, inspectors and supervising organization gets 6 cents; the railroads 15 cents, and the producers of materials and equipment 37 cents. This distribution is graphically shown in Fig. 1. These proportions would, of course, vary with the type of highway and the local labor and material market but they fairly represent the distribution on a nation-wide all-inclusive basis.

The cost distribution was arrived at by assembling cost data on specific jobs including Federal aid, and then dividing the total cost among the items of (a) Grading; (b) Structures and (c) Surfacing. These were each subdivided into (1) engineering and supervision; (2) labor on the job; (3) freight; (4) materials; (5) miscellaneous. Analysis of the cost of 3287 miles of completed Federal aid projects to June, 1921, showed that the highway expenditures on these roads were distributed as follows: Structures 12 per cent., Grading 22 per cent., and Surfacing 66 per cent. This is shown graphically in Chart No. 2.

The significance of the figures, on Chart 1 is the evidence they afford that building good roads does more than merely trade dollars for pavements. First, it gives employment in generous measure to unskilled labor, the kind which feels the pinch of hard times most cruelly; second, it means a considerable stimulus to railroads, and, third, covers

*Secretary of the Asphalt Association.

FIG. 1—DISTRIBUTION TO LABOR AND MATERIALS.

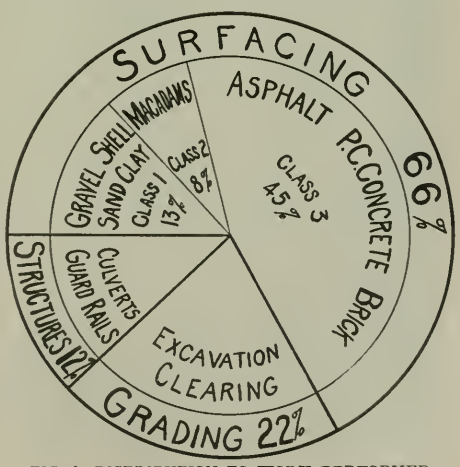


FIG. 2—DISTRIBUTION TO WORK PERFORMED.

the margin between stagnation and activity in quite a number of industries.

While it must be admitted that the production of any utility helps to give employment, there is no other comparable outlay which so completely distributes the dollar to offset effects of hard times as does highway work.

Manifestly, this showing has national significance only in the event that the expenditures assume magnitude sufficient to affect nation-wide economic conditions. In 1922 the sum available for country highways, according to Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, is $720,000,000. If to this is added only $280,000,000 for all municipalities there is an indicated total sum available of $1,000,000,000. This I believe is an ultra conservative estimate. Now *if* we spend it for roads and streets we shall in addition to buying so much pavement accomplish the following direct results:

First, we shall, on the basis of 42 per cent or $420,000,000 for labor give employment on paving jobs to 1,050,000 laborers for eight months at $2.00 per diem. This is merely an estimated basis as to the daily wage and the number of days employment but its soundness is not impaired by variations in details. Such a program, while not wholly solving unemployment problems, would mean protection against want for very nearly every unskilled laborer because it would take up the excess supply of such labor. Executive, technical and clerical workers on the paving jobs would receive 6 per cent or $60,000,000. It is difficult to average the compensation of these workers but if we parcel it out at say $2,000 per worker for the year it would keep 30,000 busy. As these employees come from specially trained classes relatively small in number, such as engineers, chemists, inspectors, mechanics and accountants, such a number would be quite influential in reducing distress among them.

Railroads would receive $150,000,000 out of a billion dollar road program and more than half this proportionate sum would be passed on to rail employees, thus further helping employment. From a rail traffic standpoint it is interesting to consider that each square yard of paved highway means a weight of materials aggregating an average of easily 800 pounds, or for a mile of 18 foot wide pavement about 4,200 tons. If the billion dollars goes into construction at an average of say $16,000 per mile it would be equivalent to 62,500 miles or a weight of materials of say 262,000,000 tons. Both of these huge totals would be reduced, the mileage by diversion of funds to maintenance, and the tonnage by the use of local materials close to the roadside; but however large the deductions, the remainders spell big transportation business for the railroads.

The 37 cents which goes to industries becomes $370,000,000 in such a program. That much money means that rock quarries, gravel pits, cement mills, asphalt and tar refineries, brick plants, road machinery factories, truck manufacturing plants, steel mills, explosives mills and contracting organizations will be kept busy. While not all of the cement output, in fact only about 20 per cent. goes into paving, and while of asphalt about 45 per cent goes into paving, and while all these other industries produce materials and equipment for other purposes than paving, it must be evident that with a vigorous boom along paving lines each of these industries would be on a satisfactory production basis and going on full time.

Now these are direct results of a great road program wholly apart from the far-reaching benefits which the paved highways confer through their service to transportation of farm products; to local travel; to country schools; to development of new resources; to the advancement generally of rural community welfare and toward the almost equally important economic development of suburban settlement.

The crux of the whole question is in the carrying out of this great program. The money is available, rail transport is sufficient, materials can be produced. Now comes the disturbing statement from many highway departments that on account of the alleged high prices for a single material, portland cement, extensive road building projects will be suspended. It is in no derogatory spirit toward portland cement that I call attention to the fact that other types of pavement than portland cement concrete may be constructed to serve every purpose at reasonable cost. Asphalt for example is actually *lower in price* than *prewar basis* and it is used in several types of pavement adaptable to local conditions as to cost limits, availability of materials and variety and intensity of traffic.

Thus the penetration type retains all of the good qualities of macadam and adds that of dustlessness and powerful resistance to disintegration. Asphaltic concrete and sheet asphalt cost little if any more than unsurfaced reinforced portland cement concrete. A large proportion of the most heavily travelled streets and highways in the world are so surfaced. During 1921 they led all paving construction with 68,000,000 square yards. It is a duty to go ahead with a one hundred per cent road program and get the keenest competition among materials and types. Economic laws will do the rest.

Colorado River Commission

Secretary Hoover was chosen permanent chairman of the Colorado River Commission at its first meeting in Washington, January 26. The discussion of the problems indicated the earnest desire on the part of the commissioners from the states of the Colorado River basin to cooperate and make the concessions necessary to a broad plan which will permit the greatest possible utilization of the water of this stream. To expedite the work of the Commission three committees were formed. One will study the questions coming under the general head of volume of water; another will consider the water requirements of each state, while the third will devote itself to a study of the legal questions involved. The Commission will meet at Phoenix, Arizona on March 15th.

Muscle Shoals

The Secretary of War, on February 2, sent the Henry Ford Muscle Shoals offer to Congress. He

made no recommendation but pointed out numerous advantages and disadvantages of the proposal. He recommends the completion of Wilson Dam by the Government if it should be decided to accept no private bid. This is based on the necessity for nitrogen preparedness, the advantages of navigation and the utilization of a great national resource. He believes the Ford offer should be further modified to conform to the Water Power Act which would limit the lease to 50 years..

Handling Concrete with an Air Hoist

Placing small or detached amounts of concrete are often slow or expensive operations on account of the difficulty of elevating the heavy material without some power appliance, and the time and expense necessary to install the heavy hoisting apparatus usually employed for concrete distribution. Such work is therefore sometimes done at a very high unit cost that, although it may be greater than the price paid for the concrete, is still cheaper than to provide heavy equipment and remove it for so small an amount of concrete.

The ingenious contractor will often be able to devise a special method for handling different jobs, and will utilize and combine available equipment for special purposes, thus effecting important economies. While these plans cannot always be duplicated on different jobs they can frequently be modified or adapted and in any event are very likely to give ideas and suggestions that will help a contractor in some other case.

In the construction of a concrete warehouse the concrete was mixed at ground level, but there was no regular derrick or hoist available to elevate it above the roof for the construction of the upper part of the building. The difficulty was overcome quickly and with very little expense by the expedient of improvizing a derrick from a 20-foot vertical mast of 6x6 or 4x4-inch timber to which was bolted and braced a short fixed transverse arm. This mast was set on the roof of the building and guyed. From the extremity of the arm there was suspended a concrete bucket filled from the mixer and hoisted by two parts of a ¼-inch steel cable led over sheaves in the horizontal arm and down to the drum of a Little Tugger hoist bolted to the foot of the mast and operated by compressed air. The concrete was dumped into a hopper bin on the roof and thence discharged to wheelbarrows by which it was distributed to the forms and placed three times as fast as could be done without the air hoist.

Wherever compressed air is available for operating pneumatic tools, drills or for other purposes at from 50 to 125 pounds pressure, it will drive the comfact, portable 2½-h.p. hoist that weighs only 285 pounds, will take 700 feet of ¼-inch rope and will hoist a 1,000-pound load at the rate of 85 feet per minute with 80 pounds air or steam pressure.

IMPROVIZED DERRICK FOR HOISTING CONCRETE

Paving Notes*

In Owosso, Mich., in laying unreinforced concrete, the contract price for 17,000 square yards was $2.47 and $.95 for 12,000 yards of excavation. In Lexington, Nebr., in connection with laying 42,500 square yards of 3-inch vertical-fibre brick on a 5-inch concrete base at $4.25 a square yard, the grading was paid for at an additional price of $.70 a cubic yard and the curb at $.90 per lineal foot.

Freehold, N. J., let two contracts, one in March and one in July, 1921, both for reinforced concrete. For the former the prices were $3.35 for the pavement, $2.00 for excavation and $.45 for curb, while in the July letting the price was $2.78 for pavement, $1.50 for excavation and $.50 for curb. In Fulton, N. Y., 2-inch asphaltic concrete on a 6-inch base cost $2.85, while a 1:1-½:3 concrete averaging 7½ inch thickness cost $2.80 and excavation cost $1.80 a cubic yard additional. Asphaltic concrete resurfacing in the same city cost $1.75 a square yard. In Glens Falls, N. Y., in laying 1,307 square yards of brick, there were 202.7 cubic yards of excavation and fill at $2.00, 236.6 cubic yards of 1:3:6 base at $14.00, 1,354 feet of expansion joints at $.25, 27.23 cubic yards of cushion mixed 1 to 2 at $19.35 and 1,307 square yards of Mack hillside brick at $3.65 laid.

In Marion, N. C., in connection with laying 15,000 square yards of concrete pavement, grading cost $.40 a cubic yard and integral curb $.47 a foot extra, the cost of the concrete pavement alone being $2.70. In laying brick pavement in Akron, Ohio, the brick and concrete base cost $172,955, while grading at $.50 a cubic yard and curb at $1.40 per lineal foot added $103,340 to the cost. In New Boston, Ohio, in addition to 10,870 feet of brick with concrete base

*Continued from page 124.

at $3.54 per square yard, the street improvement included 4,816 lineal feet of concrete curb and gutter at $.85, excavating at $.75 a cubic yard, three manholes at $55 and 8 catch basins at $55.

In Wilkinsburg, Pa., in laying concrete pavement, the cost was $2.80 per square yard for the pavement, while the grading cost $1.50 per square yard extra. In Waxahachie, Texas, a 2-inch warrenite-bitulithic wearing surface on a 5-inch concrete base cost $5.35 to $5.55, excavation cost $1.00, headers $.25, curb $.90 and combined curb and gutter $1.25. In Barre, Vt., in laying reinforced concrete pavement using 30 pound mesh, the pavement cost $2.38 per square yard, the grading $.50 and the shoulders $.40. In Suffolk, Va., grading for concrete pavement cost $.60 per cubic yard. In Green Bay, Wis., the cost of a 1½-inch sheet asphalt surface with 1½-inch binder course on 6-inch concrete base was $3.75 per square yard, in addition to which the grading cost $1.50 per cubic yard and a 5½-inch curb with combination 18-inch gutter cost $1.25 per linear foot. In Manitowoc, Wis., a 7½-inch concrete pavement cost $3.16 per square yard including grading and another cost $2.85 per square yard without grading. In Wisconsin Rapids, Wis., in laying 28,000 square yards of concrete pavement, this cost $2.69 for the pavement only while the grading averaged $.32 per square yard extra.

Notes on "Payment for Paving"

Boulder, Colo., assesses by the front foot on the paving abutting the property, and by the 25 ft. zone when pavement is parallel to property—40% of the first zone, 23% of the second, 15% of the third, 12% of the fourth, 7% of the fifth, 3% of the sixth. Intersections assessed a half block each way.

Pueblo, Colo., assesses entire cost on district improved. Each quarter block is divided into four equal zones from both front and side street. First zone pays 55% and other three zones pay 15% each of total amount chargeable against any frontage.

In New Haven, Conn., abutting property owners are assessed a flat rate for each foot of frontage, the rate depending upon the type of pavement, as follows:

Bituminous macadam.....40 cts. per front foot
Asphalt resurfacing.....50 cts. per front foot
Concrete .....75 cts. per front foot
Asphalt with new concrete base.80 cts. per front foot
Granite block with new concrete base.....$1.00 per front foot

In Champaign, Ill., the total amount of assessment for paving a given frontage is assessed on the abutting property and all lots up to the middle of the block, each lot being assessed $\frac{f\,e}{b\,c}$ of the total assessment, in which f is the depth of the lot at right angles to the street, c is the distance from the center of the lot to the center of the block, b is the distance from the center of the block to the property line of the street to be paved, and e is one-quarter the length of the block.

In Fort Wayne, Ind., assessment is by front foot after street and alley intersection have been deducted. Corner lots are assessed back 150 ft., the first 50 ft. paying 75%, the next 100 paying 25%.

In La Porte, Ind., the first 40 ft. back pays 75%, the next 40 ft., 12 2/3, and the remaining, up to the center of the block but not beyond 70 ft., pays the remaining 8 1/3%.

The Iowa law permits assessment to be extended 300 ft. back from the street paved but not more than half-way to the next street. In Ames, Iowa, the assessment is calculated by means of a curve, of which some of the coordinates are:

A lot extending 50 ft. back pays	30.56%
A lot extending 100 ft. back pays	55.56%
A lot extending 150 ft. back pays	75.00%
A lot extending 200 ft. back pays	88.89%
A lot extending 250 ft. back pays	97.92%
A lot extending 300 ft. back pays	100.00%

The percentages applying to each lot are then multiplied by the number of feet and by the total assessment per front foot.

In Dodge City, Kan., the cost of paving each block is prorated to the property on that block in proportion to value of each property as set by an appraisal board.

In Pratt, Kan., the city pays for intersections and grading.

In St. Paul, Minn., the charter provides that only the cost of a strip of pavement 12 ft. wide immediately in front of and abutting the property can be assessed. Assessments are made for benefits to property on intersecting streets half-way toward the next parallel street.

Natchez, Miss., pays for paving by issuing certificates to contractor.

In Columbus, Neb., the assessment is based on frontage assessed back to the center of the block, the first sixth paying 33 1/3%, the second sixth 20%, the third sixth 16 2/3%, the fourth sixth 10%, the fifth sixth 10%, and the sixth sixth 10%.

In Garfield, N. J., the two-thirds assessment on the abutting property is by the front foot with a gradual reduction proportioned to the depth of lots up to 80 ft.

In Newark, N. J., for original paving on purely residential streets with light traffic, customary to assess entire cost on property. For resurfacing or repaving, not more than one-third is paid by city at large and two-thirds assessed on property frontage. "It has been planned recently, in view of the heavy through traffic on many of our main highways, to place three-fourths of the cost on the city at large and only one-fourth on the property frontage. If means can be formulated for financing this proposition, either three-fourths or four-fifths of the cost of repaving will be assumed by the city at large on heavy-traffic streets."

In Summit, N. J., "if ordered by Common Council, Board of Assessors assesses abutting property according to benefits received—otherwise city pays whole cost. The latter is the usual procedure." Assessment is generally by front foot.

In New Rochelle, N. Y., three feet of pavement on each side of the street is assessed as gutter.

In Queens Boro, New York City, if the assessment exceeds 60% of the assessed valuation, the owner is allowed 10 years for paying same.

Table No. 3—Methods of Paying for Paving—Continued

Name of City	Percentage of Paving Cost: Assessed on abutting property.	Percentage of Paving Cost: Paid in city.	Method of Calculating Assessments	Payable in how many instal-ments.	Funds obtained by city by	Life of bonds, years.
Illinois (Continued):						
Marion	all	.....	By front ft. with reductions on corner lots.	10	budget	..
Mattoon	90%-95%	5%-10%	Front ft., excl. intersections.	10	budget	10
Morrison	80%	20%		10	cash	10
Murphysboro	.....	.....	Front foot.	10	budget	10
Ottawa	95%	5%	By benefits.	10	.....	..
Peoria	all	.....	By front ft., incl. intersections.	10	.....	10
Quincy	75%	25%	By front ft., excl. intersections.	10	bonds & benefits	1-10
St. Charles	85%	15%	By front foot.	10	tax—budget	10
Streator	.....	5%-15%	By front foot.	10	bonds	10
Waukegan	most	.....	By front foot.	10	assess.—bonds	1-10
Wheaton	all	.....	By front ft., excl. intersections.	10	taxation	2-10
Wilmette	90%	10%	By front foot.	10	budget	10
Indiana:						
Bedford	all	.....	By front foot.	2	.....	..
Bloomington	all	.....	By front ft., excl. intersections.	10	budget	10
Brazil	all	.....	By front foot.	10	budget	10
Covington	all	.....	By front ft., excl. intersections.	10	tax	1-10
Crawfordsville	all	.....	By front ft., excl. intersections.	10	budget or special levy	10
Elkhart	all	.....	By front ft., excl. intersections.	10	budget	10
Elwood	all	.....	By front ft., excl. intersections.	10	budget	..
Fort Wayne	all	.....	By front ft., excl. intersections, (see note).	10	budget	10
Gary	all	.....	By front ft., excl. intersections.	10	budget	..
Kendallville	all	.....	By front ft., excl. intersections.	10	budget	10
Lafayette	all	.....	By front ft., excl. intersections.	10	budget	10
La Porte	all	.....	By front ft., excl. intersections, (see note).	10	both	10
Marion	all	.....	By front ft., excl. intersections.	10	bonds	10
Mt. Vernon	all	.....	By front ft., excl. intersections.	10	budget or bonds	10
New Albany	all	.....	By front ft., excl. intersections.	10	budget	10
Noblesville	all	.....	By front ft., excl. intersections.	10	budget	10
North Vernon	.....	.....	.....	10	gen. fund or bonds	..
Peru	all	.....	By front ft., excl. intersections.	10	budget	..
Portland	all	.....	By front ft., excl. intersections.	10	budget	10
South Bend	all	.....	By front ft., excl. intersections.	10	budget	..
Wabash	all	.....	By front ft., excl. intersections.	10	both	10
West Lafayette	all	.....	By front ft., excl. intersections.	10	budget	10
Iowa:						
Ames	.....	.....	(See note).	10	budget	..
Atlantic	all	.....	Area of lots.	7	bonds	7
Boone	all	.....	Frontage plus intersections.	10	.....	..
Cedar Rapids	all	.....	Front foot.	10	budget	..
Centerville	all	.....	Area of lot or tract.	10	bonds	10
Cherokee	all	.....	(See note).	10	bonds	7 or 10
Clinton	all	.....	Area.	10	bonds	10
Des Moines	all	dist. improv.	Front ft., incl. intersections.	7	bonds	5-12
Emmetsburg	all	50%—city	Front foot.	7	bonds	10
Fort Dodge	85%	15%	Front ft., divid. area into zones.	10	bonds or impv. levy	..
Indianola	.....	.....	.....	7	bonds & special assessments	..
Iowa City	all	.....	Area (see note).	10	bonds	5-15
Jefferson	.....	.....	By front foot.	7	bond	..
Keokuk	all	.....	Area of lot, excl. intersections.	10	.....	4
New Hampton	all	.....	.....	7	.....	..
Newton	all up to 25% of property	deficiency	Front ft., & depth, incl. intersec.	7	bonds	10
Oelwein	all	.....	Front ft., excl. intersections.	7-10	bonds	10
Oskaloosa	.....	.....	Zone system (see note).	10	.....	10
Ottumwa	all	deficiency	Area of lots, intersections pro rated on abut. property.	10	budget	..
Perry	all	.....	Front ft. & area, incl. intersecs.	7	.....	..
Storm Lake	all	.....	By front foot.	..	.....	..
Kansas:						
Atchison	all	.....	Area of lots, excl. intersections.	10	bonds	1-10
Chanute	all	.....	Intersections by city.	10	.....	..
Dodge City	all	.....	Intersections by city (see note).	20	bonds	1-20
Emporia	all	.....	Valuation of property, intersections by city.	10	bonds	10
Hiawatha	all	.....	By front ft., intersecs. by city.	10	bonds	10
McPherson	50%	50%	Valuation of lot.	10	.....	10
Ottawa	all	.....	Feet of ground, excl. intersecs.	10	bonds	10
Parsons	all	.....	On area, excl. intersections.	5-10	budget or bonds	5-10
Pratt	.....	.....	By front foot.	20	bonds	10-20
Salina	all	.....	By front foot.	10	bonds	5
Topeka	all	.....	Intersections by city.	10	bonds	1-10
Wichita	all	.....	By block acc. to value of lots, intersections by city.	10	bonds	1-10
Kentucky:						
Ashland	all	.....	By front ft., intersecs. pro rated.	10	.....	10
Covington	all	.....	By front ft., excl. intersections. On reconst. 50%—50%.	10	budget	10
Owensboro	all	.....	By front ft., excl. intersections.	10	budget	10
Paris	⅔	⅓	By front ft.	10	bond	20
Louisiana:						
Lafayette	⅔	⅓	Gravel pav't ent. by bond issue.	5-10	bonds	20
Lake Charles	all	.....	Includes intersections.	4	.....	..
New Orleans	all	.....	Front ft., incl. intersecs.	10	budget	10
Maine						
Augusta	.....	all	.....	..	budget	..
Gardiner	.....	all	.....	..	budget	..
Portland	.....	all	.....	..	annual appropriation	..
Walterville	.....	all	.....	..	budget	..
Missouri:						
Frederick	50%	50%	Cost, incl. intersections pro-rated per front ft. of prop.	due in 20 days	budget	..

(To be continued)

In Mandan, N. D., paving on side streets is assessed against corner lots in the business district, but in the residence district to one-fourth of the lot.

South Sioux City, Neb., pays for intersections by issuing general obligation bonds on which a levy is made each year.

In McAlester, Okla., "the total cost of a quarter block is assessed 40%, 30%, 20% and 10% to the center of block for side street and per front foot for frontage."

In Bellingham, Wash., the area is divided into zones, the first 30 ft. paying 45%, the second 30 ft. 25%, the third 30 ft. 20%, the fourth 30 ft. 10%.

In Raymond, Wash., the assessments can be paid in as many annual instalments as the years for which the bonds are issued (not over 10 years) less two.

Oshkosh, Wis., assesses benefits and damages on all except city property and crossings up to $3.00 per sq. yd., assessed by front or average width of lot.

In Waukesha, Wis., if paving is by petition assessment is by the front foot. If it is involuntary, benefits and damages are assessed.

California Street Paving Discussed

In the recent convention of the League of California Municipalities the matter of pavements for city streets was discussed. C. C. Kennedy, formerly city engineer of Berkeley, leading the discussion.

Mr. Kennedy stated that he believed only two types of pavement were practicable under California conditions, the asphaltic type and the hydraulic cement type, or a combination of the two. In all types of pavements the bearing power is furnished by rock and rock products, which are necessarily more or less local in origin, and failures of pavements have been due to lack of stability within the mass of these materials. The aim is to determine the most economical method for making the materials stable.

The cost of a pavement includes first cost, maintenance cost and renewal cost, combining to form the structural cost. In addition there is the unit cost of transportation over the pavement. The latter has not yet received sufficient attention. The tractive resistance to a load represents less than 20 per cent of the actual cost of transportation, mechanical repairs, the wear on tires and other features being represented by the remaining 80 per cent.

There is a third feature to be considered in economy of pavement and that is the interruption to business during construction, renewal and maintenance work on pavements. Mr. Kennedy cited the instance of a station selling automobile supplies which, when the street leading past it was being paved, lost $100 a day due to decrease in business during the period of such construction. This was but one concern on the street and it is readily seen that the loss by all the business establishments affected by the closing or partial closing of a street during construction or repairs might total to a very large amount for each day that the street is wholly or partly closed to traffic.

In the matter of maintenance, the problem of the small city differs from that of the large one, in that the former cannot afford to maintain a municipal organization for maintenance and repair, and therefore should give preference to a pavement which does not require a special maintenance organization. "As a general principle it might be stated that in a small community a more permanent type of improvement is economically a sounder type to construct."

Discussing the history of asphaltic pavements in California, the author stated "there are cases of failures, but I think nearly all failures of asphaltic macadam type have been due to insufficient care in drainage of the subgrade, insufficient care in the selection of the type of rock, and insufficient care in the actual manipulation of the application of the material. There is quite probably a limit to the amount of traffic which such a road can carry economically. Nevertheless, for communities which are demanding the improvement of streets throughout all their districts, there is no question but that this type today offers a great possibility for a municipality in residential districts."

Concerning hydraulic cement concrete pavement, he stated that no pavement is permanent and that a concrete pavement like others must be maintained and repaired. Even where structural conditions are perfect the impact of traffic will cause the failure of the surface from fatigue, when surface patching will no longer suffice. When extensive repair on concrete roads is necessary, the most logical method is surfacing with bituminous material.

Mr. Kennedy had found most concrete to be sufficiently porous to exert capillary attraction on the subgrade moisture, and in all cases where he had investigated failure of asphalt surfaces on concrete base, he had never failed to find moisture on the top of the concrete beneath the asphalt when movement of the asphaltic surface had occurred. Therefore the securing of impermeability in the base, or concrete pavement to be used later as a base, is a very important matter. This would seem to be an argument in favor of bituminous base in place of cement concrete. In removing an asphalt wearing surface from a concrete base he had noticed not only the presence of moisture on top of the concrete but also that there was apparently no "life" to the bottom of the asphalt mixture and that the volatile materials appeared to be confined to the top three-quarters of an inch. Apparently an emulsion with the water was formed at the bottom of the asphalt material, which removed the cementing power of the asphalt.

Concerning the effect of gasoline on asphalt pavements, S. B. W. McNab of San Bernardino stated that ten years ago they had had trouble with asphalt being dissolved out of the pavement by gasoline and were much alarmed about the matter, but found that after a time the pavement hardened and afterwards stood the dripping of gasoline as well as a concrete pavement would. This instance was cited in corroboration of a statement by Mr. Kennedy that a single case of leakage of gasoline probably would not seriously damage a pavement, because if it was not removed but was left in place it would harden with the evaporation of the gasoline.

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Assessments for Paving

In response to a number of requests for the information, we included in this year's paving questionnaire inquiries concerning the amount of paving costs that is assessed against abutting property and certain details of the methods employed. A part of the replies appear in this week's issue, and the rest will be published next week and the week following.

These show no universal or even general practice as to methods except that the great majority base the assessment on the front foot rather than the area of the abutting property. But the part of the cost assessed varies from nothing to all, one-half and two-thirds being popular fractions. Some include and some exclude the street intersections; some assess for repaving, others do not; various plans are employed to assess for side street frontages; some assess for a certain fixed width of pavement.

Apparently very few employ the plan that seems to us most logical—that of assessing against all residential property a fixed sum per front foot, such sum being the average cost of a type and width of pavement suitable for a purely residential street with no through traffic.

In a number of states state laws fix certain of the essential features of the assessment, some of which are evident from the replies tabulated, as in the cases of Indiana, Iowa and Ohio.

Highway Construction and Labor

Two-thirds of the money spent on highway construction goes to labor—nearly half of it directly to the laborers employed on the road, the rest to labor used in producing the material and transporting it.

This is the average of more than three thousand miles built by Federal aid. Some road will use less labor, some more. But Mr. Pennybacker shows in this issue that, of the more than a billion dollars available for paving this year, $660,000,000 will reach the laborers almost directly in the form of wages. This should help some in solving the unemployment problem.

Brisk Highway Bidding

An indication of the correctness of our belief, stated last week, that bids on public work would be more numerous and lower than a year ago is furnished by the letting held a few days ago for road and bridge work in Randolph County, Missouri.

The engineer's estimate of cost was made in May of last year, and three bids were less than sixty per cent. of that estimate for the entire work, while nine were under sixty-one per cent. for the road work alone. The total number of bidders was 22 on the road work and 23 on bridge work.

The closeness of the bidding is indicated by the fact that thirteen of the bids were within 20 per cent. of the lowest on the road work alone, and eleven on bridge work alone, which was of reinforced concrete.

This was a small contract as highway contracts run now—the low bid was $37,734—and the fact that so many bidders came from four states to bid on it would seem to indicate that there are plenty of contractors in the field for work this spring.

A Good Record

During its existence of less than two and a half years the Associated General Contractors of America has done much to co-ordinate construction interests, to equalize and standardize various construction features in different localities, to improve construction standards and the esprit de corps to the advantage of contractors themselves and to a public benefit fully justifying its existence and indicative of increasing future prestige.

It has provided a sort of federation of individual, corporate and sectional contractors' associations that has materially benefited the component elements of the association, affording them co-operative advantages and reducing some of their difficulties and expenses while it has provided the central national organization that is being developed to a potentiality of great public and technical benefit.

It has become a dignified and authoritative organization of good repute and acknowledged influence recognized by the state and federal governments and by other national organizations with

which it co-operates. Its creation and development have been warmly endorsed and promoted by PUBLIC WORKS, and especially by its component journal, "CONTRACTING," which always labored strenuously to inspire, promote, and assist such an organization. It is the earnest wish and expectation of PUBLIC WORKS that the A. G. C. increase continuously in power, in prestige and in efficiency that may even make it within a brief time an instrument of tremendous power in rehabilitating the construction industry and establishing it on a safe and honest basis for continuous prosperity.

Among the excellent results of the convention in Cleveland, January 17, were three especially important resolutions that were passed instructing the executive board to make an immediate survey of the question of apprenticing the building trade, to secure sufficient apprentices for future needs; endorsing the preparation of plans for public works well in advance of construction; and the approval of an open market for all materials and opposition to all combinations to fix prices or to limit employment to any class or organization or persons.

Discussion of "Sewage Treatment in Imhoff Tanks"

Editor of PUBLIC WORKS:

In response to a request of Mr. Riker, I beg to offer a brief comment on the subject-matter of his timely article relative to the Imhoff tank, which recently appeared in PUBLIC WORKS.

The very prevalent faults of the two-story tank enumerated in Mr. Riker's article will probably be conceded by most engineers. The portions of his paper of greatest interest to me are those referring to the probable causes of the difficulties described and suggestions for their alleviation or avoidance.

From observation, I have come to the conclusion that foaming and related difficulties arise from a combination of high viscosity of the liquid in the lower compartment and the concentration of escaping gases at the vents. Like Mr. Riker, I fail to see that there is any great difference in bacterial action in single-story and two-story tanks. The liquid in the lower chamber remains unrenewed for considerable lengths of time and in continuous contact with masses of decomposing organic matter, some of which is always entering into solution. The liquid becomes surcharged with soluble matter. Its specific gravity increases. Particles which settle readily in the upper chamber, where the specific gravity of the liquid is less, will not settle in the lower chamber. Matter previously deposited in the lower chamber will float and intensify scum formation or become semi-buoyant and distributed throughout the liquor, as the specific gravity increases. Gas-buoyed matters are retained in increasing quantities throughout the liquid, being unable to escape as in the single-story tank. Under these circumstances, more or less intercommunication takes place through the settling slot and balanced solids find their way into the flowing-through chamber. Escaping gases form bubbles and froth at the surface of the viscous liquid in the vents, and entrain scum and suspended matters, the foaming being intensified by small vents, or the restriction of relatively large ones by scum. Excessive accumulations of scum and restrained gas may extend down to, and escape up through, the slot.

This foaming in Imhoff tanks is, I think, somewhat analogous to the priming or foaming in steam boilers. To quote Rogers' "Manual of Industrial Chemistry": "Foaming results when anything prevents the free escape of steam from the water and the principal cause of it is believed to be an excess of dissolved matter that increases the surface tension of the liquid——." That is, the concentration of dissolved matters brought about by the distillation process of steam formation, increases the viscosity of the boiler contents to a point where foaming occurs. Oil on the surface will also increase the surface tension. "Blowing off is about the only practicable means of preventing foaming——." In the process of blowing off, only a part of the water is removed.

Similarly, the remedy for Imhoff tank foaming appears to be the partial replacement or dilution of the liquid in the lower compartment, and the removal of scum from the vents. This may be done from time to time or continuously. A simple method of accomplishing periodical dilution is by frequent withdrawals through the sludge pipes, by which a part of the thickened liquor is removed and replaced by fresh sewage by way of the settling slot. This also reduces the volume of the fermenting sludge and curtails gas production. The scum difficulties are left untouched. But this deprives the tank of one of its most important functions—sludge disgestion—which has been secured at a considerable additional construction cost.

Continuous dilution may be effected by the diversion of a portion of the effluent to the lower chamber, somewhat after Travis' original design. If I recollect rightly, Mr. Alexander Potter embodied this in one or more of his early designs. Mr. W. G. Kirchoffer states that he has corrected the difficulties at several Wisconsin tanks by introducing the fresh sewage into the lower chamber. To what extent the effluent may have been rendered odorous, or the characteristic Imhoff sludge affected by this arangement, I do not know. Provision may be made for scum removal.

A more complete method of effecting periodical dilution consists in temporarily closing the tank outlet and withdrawing the scum and a part of the thickened liquor through gated openings along the vents. The discharge is delivered through a steeply sloping channel to the sludge bed. Fresh sewage flows down through the slot to replace the liquor withdrawn, giving the desired dilution. The sludge remains undisturbed. Unless the plant is isolated, the sludge bed should, in my opinion, be of the covered type to avoid nuisance. This arrangement is along the lines of the Westmont tank, but may be so designed that no pipes or troughs are placed in the vents.

The experience at Oaklyn, where an excessive withdrawal of sludge caused foaming, seems to contradict the foregoing explanation. Mr. F. E. Daniels of the Penn. State Dept. of Health, cites cases similar to this one at Oaklyn, and states that it appears to be necessary to draw the sewage level well down in the tank to bring about foaming. Nevertheless, the bulk of the foaming data tends to indicate, in my opinion, the probability of the general correctness of the theory advanced above, though doubtless the action is not as simple as I have indicated and unknown factors may at times produce unexpected developments.

Instead of attempting to use the two-story tank as a primary unit, with corrections as described, it may be used as a relatively small secondary unit to correct the unloading of a single-story septic tank. Placed in series, a short-period Imhoff unit, with a disproportionately large sludge chamber, will act as a trap tank to intercept and retain the solids unloaded by the primary unit. A secondary Imhoff unit, receiving decomposed sewage, will not foam and produces little scum. The solids unloaded by the primary tank will settle if agitated sufficiently to release entrained gases. Such agitation can be simply secured between the two units. If the secondary unit is of the single-story type, it will itself unload as soon as septic conditions become re-established in it, although not so vigorously as the primary unit. This was clearly shown by the earlier Columbus experience. The arrangement suggested does not remove the objection to a foul-smelling effluent, unless the primary unit is designed to permit but a limited detention period.

The writer has, in general, avoided the use of primary Imhoff tanks.

Respectfully,

Waldo S. Coulter.

Homemade Paver-Charging Equipment

Dump body mounted on old Ford car, and flanged wheels attached, dumps directly from industrial track into skip

In the construction last season of the 7-mile section of concrete roadway for the National Old Trail in Hancock County, Indiana, the C. M. Kirkpatrick Co., Indianapolis, contractor, facilitated the work by the use of a mechanical loader and a specially designed home-made equipment for transferring aggregate and cement from sub-grade storage and charging it into the mixing machine in a rapid and continuous manner involving a minimum of hand labor. This equipment enabled the 18-foot pavement 6 to 8 inches thick to be concreted at an average rate of 417 linear feet per 10-hour day by a total force of only 22 men.

Sand and gravel were derived from a pit owned by the contractor adjacent to an electric car line that parallelled the highway and delivered the aggregate, which was stored in alternate piles on the subgrade on one side of the highway while the other side was left free for trucks to deliver the cement bags which were piled on slightly elevated platforms and carefully covered by tarpaulins, on the shoulders of the road. The platforms were mounted on skids easily hauled forward as the work advanced.

The cement and aggregate were hauled to the paver over a 100-foot section of 24-inch gauge industrial track with 2x6-inch ties having their ends fastened to and supported on a pair of 2x4-inch wooden stringers. A 3-foot section of the forward end of the industrial track was hinged so that it could easily be revolved back and forth and lie in the bottom of the charging skip when the latter was lowered to the ground and be quickly moved clear of it when the skip was raised to charge the paver. As the paver advanced the track was moved forward as a unit by a single horse and tackle.

The gravel was reclaimed from the stock piles on subgrade by a Barber-Greene loader with measuring box that delivered to the special delivery car, which also received sand shoveled by hand from the subgrade stockpile by three men who filled a couple of elevated tilting boxes that dumped into the car. Cement was placed in the batch car by two men. The car made a round trip, delivering the material to the mixer and returning for another load in one minute.

The material car was of special design and of home-made construction, utilizing the power plant and transmission drive shaft and rear axle of an old Ford car which were mounted in a new frame with flanged cast wheels. The old Ford rear axle was fitted with a sprocket wheel and chain drive, operating the rear wheels of the new car and giving it independent locomotion at good speed.

The broad dump body, resembling an ordinary skip mounted on the rear of the car, was balanced so as to dump automatically when the catch was released. The forward end of the industrial track was raised about 15 inches so as to give the car sufficient elevation to enable the dump body to revolve into an almost vertical position, insuring the rapid and complete discharge of its contents.

The entire plant was operated by 22 men, including one operator and 2 helpers on the Barber-Greene loader, 3 sand shovelers, 2 cement men, 1 man operating charging car, 2 men spreading wet concrete, 3 men finishing, tamping and rolling concrete, 1 man operating paver, 2 men on fine grading, 1 man with team, 1 man covering concrete with straw and 1 man sprinkling it, and a foreman.

With this force the daily average progress for a 10-hour shift was 830 square yards or 170 cubic yards, equivalent to a batch every 2 minutes and 1 second. The maximum record was 1088 square yards or 222 cubic yards, equivalent to one batch in every 93 seconds. A total of 77,354 square yards of this pavement was laid in 1921 under the direction of Ross Cox, superintendent.

The use of the loader saved the wages of 5 men and the equipment described was developed from the use of a small dump car pushed by hand over a short narrow-gauge track to convey materials to the paver. This answered so well for small work using a small paver that the system above described was installed and worked economically and satisfactorily for the large paver.

MEASURING AND LOADING SAND AND GRAVEL.

LOCOMOTIVE MATERIAL CAR SERVING PAVER.

Municipal Garbage Collection Abandoned

Hamilton, Ohio, a city of about 40,000 population, has been forced to exercise the strictest economy because of the Ohio law forbidding deficits in operating expenses of cities in that state. The police force has been reduced to 12 from more than 40. Garbage collection last year cost the city

$36,000 but this year is abandoned entirely as a municipal enterprise, each householder being required to arrange for the removal of his own garbage. A collector arranges for removing the garbage at a charge of 15 cents per week per residence.

Associated General Contractors

Resolutions adopted by the convention of this society at Cleveland

The Committee on Resolutions reported among others, the following resolutions, which were adopted:

The A. G. C. declared itself opposed to raising wages in foreign territory. The Committee on Ethics was directed to adopt as part of the Code of Practice set forth in Art. V of the Rules of Procedure, a section embodying this attitude.

The Executive Board was instructed to make an immediate survey of the question of apprenticeship in the building trades in order to modify the present system and secure sufficient apprentices for future needs.

The preparation of plans for public works well in advance of construction was endorsed.

The leadership in removing restrictions which prevent American youth from adopting employment in construction as a life work was accepted for the A. G. C.

The abolition of advertisements which tend to misinform as to costs of construction was urged.

The adoption generally of a program for the increase of such facilities as transportation, irrigation and reclamation, hydro-electric and internal waterways development was recommended.

Public cooperation to provide transportation facilities and unified freight terminals was urged.

The creation by the Federal Government and by the States of departments to direct all features of physical development in territory under such jurisdiction was urged.

Cooperation between all elements of the construction industry—manufacturers, engineers, architects and builders—was urged toward recognition of the public interests, with publication of all facts relating to the organization and activities of each industry.

The President of this Association was instructed to call the attention of the Federal Reserve Board to the necessity of allocating sufficient funds to permit the construction of projects needed by the public.

Unqualified approval of an open market for all materials, and opposition to all combinations to fix prices or to limit employment to any class or organization of persons, was declared.

The expression of sympathy with the Lockwood and Dailey investigations was renewed. The Committee on Ethics was requested to include in the Code of Ethics of the Association a statement of principles, that none who adopt the standard of this association shall engage in illegal trade practices. The publication of these principles to acquaint the public with the high standards maintained by this association, and the display by members of the Association of the seal and motto of the A. G. C. as pledge of their consecration to high standards, were urged.

SUGGESTED PROGRAM FOR 1922

Participate actively in work of Permanent Construction Committee of Department of Commerce to establish national standards for the construction industry; urge fall lettings of highway officials' works; secure joint conference of highway officials on highway problems; urge construction of reclamation and public works by contract; urge award of contracts on a basis of skill, integrity and responsibility.

LEGISLATION

Follow bond premium case to Supreme Court; urge National Department of Public Works; urge passage Navy contractors' relief bill; urge passage War Department contractors' relief bill; urge effective water power development act and provision for proper functioning of Federal Power Commission; secure adequate railroad legislation; secure passage of constructive immigration legislation; urge revision of detrimental State laws affecting highway work.

METHODS

Hold conference of Construction Cost Accountants to develop standard system of cost accounting; develop standard estimating forms for builders and highway contractors, quantity take-off rules, estimating guide sheet for buildings, highways, etc.; urge payment for estimating where quantities not given; extend equipment rental schedule; hold conference on standardization of equipment; study and begin standardization of construction methods.

CONTRACTS

Develop universal document and standard contracts; urge award of contracts on basis of skill, integrity and responsibility; complete an equitable equipment rental lease.

LABOR

Urge reorganization of labor unions into fewer branches, including related crafts; urge revision of apprenticeship rules and increase number of apprentices; maintain National Board for Jurisdictional Awards in the building industry; secure special construction engineer for Construction Division of National Safety Council; urge standard construction safety code; urge creation of national Conference board.

TRANSPORTATION AND MATERIALS

Secure reduction in freight rates on construction materials; secure restriction or elimination of preferential allocation of cars, to provide equal sharing by all industries; secure free wholesale market for materials; secure elimination of inequitable trade practices, affecting terms of sales, delivery and payment.

MISCELLANEOUS

Co-operate with Hoover Committee to standardize codes; study existing laws on codes—State, municipal, Federal; extend the Contractors' Service Corporation among local chapters; revise, systematize and standardize Compensation Insurance, Classification and Rates; study existing insurance and surety laws—State, municipal and Federal; formulate and issue Code of Ethics for contractors and relations with sub-contractors; develop research work and investigation, especially in methods, contracts, and materials, legislation and transportation.

Recent Legal Decisions

BIDS MUST CONFORM TO PUBLISHED NOTICE TO BIDDERS

A notice inviting bids for the furnishing of a truck to be used in the fire department of a city specified a two-wheel, front-drive aerial truck of not less than 100 horse power. A bidder proposed to furnish a machine of an entirely different character as a substitute for that described in the notice to bidders, at a lower price than the bidders according to the specifications published. The statute did not require the publication of specifications, but it was done in this case, and all bidders had equal opportunity to learn the character of the truck desired. The New Jersey Supreme Court holds, International Motor Co. v. Mayor, etc., of City of Plainfield, 115 Atl. 391, that the city was not required to consider this proposal. The "lowest bidder," within a statute requiring municipal contracts to be awarded to the lowest bidder, must be a bidder who conforms to the requirements of the notice to bidders, and not one who proposes a substitute not conforming to the published specifications. The reservation by the common council of a city of the right to determine which of different trucks offered is best for the city, is limited to proposals for a truck of the required character, and the legality of the reservation cannot be questioned by a bidder whose proposal does not comply with the notice to bidders, for he has no right to compel the acceptance of his bid, and no interest in the determination of the question between other bidders whose proposals conform to the specifications. Whatever rights the latter may have do not concern it, for it was not a proper bidder.

AUTHORIZING CONSTRUCTION OF STREET RAILWAY LINE HELD A MUNICIPAL, NOT A COURT QUESTION

In a suit by residents of a city street to enjoin the installation of a double-track street railway in the street, the Michigan Supreme Court holds, Van Baalen v. City of Detroit, 185 N. W. 883, that, under the facts of the case, the conferring of the authority to construct the line and to widen the pavement because of changed conditions, was a municipal question and not a question for the courts. The court added that: "The possibility of being obliged to submit to the construction of a street railway in front of one's residence is one of the penalties of living in a growing city."

CONSTRUCTION OF JOINT ADVENTURE AGREEMENT TO CONTRACT FOR GOVERNMENT WORK

In an action by the two members of a firm doing a contract business constructing and building roads against another construction company, the evidence showed that the plaintiffs were invited by the defendant to join in procuring a road construction contract with the government, and to become jointly interested therein; that they assisted in procuring the contract, and turned in their road constructing outfit. The contract with the government provided for additional work and for changes in the plans from time to time. The defendant objected that a payment by the government for the work done in cleaning the Salada creek in connection with mosquito prevention, and work done in building a dam across the Salada for the construction of a swimming hole for the soldiers at Camp Travis, was not within the contemplation of the parties when they entered into the agreement to share the profits. The Texas Court of Civil Appeals held, Failey Method Co. v. Kelly, 235 S. W. 250, that, the evidence showing that all the work performed with the government was done under the contract which the plaintiff had assisted to procure, and no other, and that all payments were made for work done and performed under the terms of this contract, and no other, the plaintiffs were entitled to participate in the profits of the items mentioned.

PROOF OF AMOUNT OF STONE FURNISHED ROAD CONTRACTOR BY MATERIALMAN

In an action by a materialman on a highway contractor's bond for the balance due for stone furnished the contractor, the plaintiff claimed delivery of 15,166 cubic yards. The defendant admitted receipt of 10,738. The trial court found that 13,775 cubic yards were delivered. The defendant's claim was that the total amount of stone required to construct the highway as finished was but 10,738 cubic yards; but its expert witnesses differed somewhat as to the amount required, owing to their making a slightly different percentage allowance for compression. They both stated that their figures were dependent upon the subgrade being perfectly level and so prepared that but six inches of solid material were at any time needed to make the surface conform to the contracts and specifications. In view of the uncertainty of the proof as to the exact number of cubic yards delivered or required to construct the road, the Michigan Supreme Court, in Producers' Stone & Gravel Co. v. Chicago Bonding & Surety Co., 185 N. W. 703, sustained the finding of the trial court on this point.

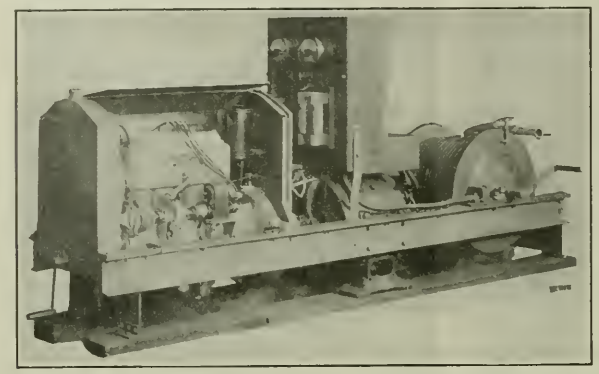
It was held that the fact that the specifications were referred to as to the kind and quality and amount of stone required by the contractor to perform the contract with the municipality did not make the plaintiff a subcontractor, there being no showing that the plaintiff undertook to perform any part of that contract.

EXTENT OF DELEGATED POWER OF MUNICIPALITY TO CHANGE CONTRACT RATES

The New York Appellate Division holds, Tonawanda Board & Paper Co. v. City of Tonawanda, 190 N. Y. Supp. 874, that while the statute delegating power to a municipality to regulate rates becomes a part of a contract between the municipality and a consumer for the supply of water, that power may only be exercised when it appears that the rate agreed upon is not just and reasonable under the circumstances, and it may not be exercised capriciously or arbitrarily. The municipality has the burden of proving its right to change the contract rate, and must propose or establish a rate that is just and reasonable in its place.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



"CAPITOL" GASO-ELECTRIC THAWING SET

CAPITOL PIPE THAWER

The Capitol Gaso-electric Thawing set built by the Auto Engine Works is a portable plant, mounted on a truck and intended for electrically thawing frozen service underground water pipes. It is equipped with a generator and its operating engine, and furnishes electricity to the reeled cable, one end of which is connected to the nearest fire hydrant and the other end to the generator and to the service pipe in the building, thus providing a complete circuit for the current, which is regulated to provide sufficient electric resistance in the service pipe to thaw it out in from 5 to 15 minutes average 11 minutes per thaw.

The 35-h.p. engine is equipped with speed control, and the generator furnishes a current of 20 kilowats. Terminal fittings are made universal, connected to all existing connections and the reel is arranged to reel out the required length of the cable and reel it up again. The truck is 10 feet long, weighs approximately 2,800 pounds and is equipped with 500 feet of cable.

DUMP WAGONS FOR REFUSE

This dump wagon especially designed for handling refuse, is manufactured by John H. Holzbog & Bro., who claim for it extra large capacity, low hanging bed, light weight and end dump. It is made in a 1-horse size of 3 yards capacity and a 2-horse size of 5 yards capacity. The body is dumped by a toggle arrangement, operated by a hand windlass and is pivoted near the rear end at a point, which permits the body to be elevated into a nearly vertical position with the lower ends at or near ground level. It is claimed to be especially adapted for dumping into barges and hauling to incinerators and is arranged to be hauled by horses for the convenient collection of refuse from house to house, after which at a common meeting place the horse poles can be readily shifted for short trailer poles and a string of wagons hauled as trailers by a motor truck, to a remote destination.

REDFLEX HIGHWAY DANGER SIGNALS

This signal contains no light or mechanism. When approached by automobile lights it appears to be a huge, brilliant red light. It has 144 lenses, reflecting 12 square inches of light and functions through fog, mist or rain. It is easily installed and requires no attention; it is manufactured by the Automatic Signal & Sign Co.

THE REFLECTO-LUX LANTERN

The Westinghouse Electric & Manufacturing Company has recently developed a post top of novel design for use with Mazda "C" lamps. The quality of the light emitted by the Reflecto-Lux units is brilliant and sparkling, and they have been designed to distribute a flood of light on the streets, with a small amount upwards to light the fronts of the adjacent buildings. The maximum light is emitted at approximately 20 degrees below the horizontal and the distribution is ideal for mounting heights and spacings customary with ornamental street lighting.

The distribution is obtained by upper and lower parabolic reflectors, which direct the light outwards and, in addition, a portion of the light in the upper

HOLZBOG DUMP WAGON FOR HAULING REFUSE

REFLECTO-LUX LANTERN FOR EFFECTIVE STREET LIGHTING

hemisphere is re-directed by an opal glass band around the upper hemisphere of the lamp, or by a band of enamel on the lamp itself.

The construction of the Reflecto-Lux units is rugged, the frame is of galvanized cast iron, and the glass panels are set in felt gaskets, making the whole thoroughly dust-proof. In the post top, the lamp burns in a "tip up" position and is readily accessible for cleaning and replacement through the hinged top cover. In the pendant unit, the lamp burns "tip down" and access is obtained to the interior of the lantern through the bottom casting, which is hinged.

NEW PILE-DRIVING ATTACHMENT FOR P & H EXCAVATOR-CRANES

To extend still further the application of P & H Excavator-Cranes, a new pile-driving attachment has been developed by the Pawling & Harnischfeger Co. This can be used in

PAWLING & HARNISCHFEGER PILE —DRIVING ATTACHMENT FOR EXCAVATOR CRANES

place of the Standard Boom, the same as the Shovel Attachment and Road-grading Skimmer Scoop. These P & H machines have been used for pile-driving work before by contractors who rigged up their own pile-driving attachment. The new standardized attachment makes unnecessary this work and makes it possible to change over in shorter time.

The construction as shown in the accompanying illustration consists of two offsetting brackets hinged on the sheave wheel pin at the head of the boom, with horizontal bracing below. The weight of the hammer is 1964 pounds and of the follower 781 pounds. The entire machine can be moved from pile to pile by the same operator, since the attachment is made for use with either 205 or the 206 corduroy traction machine.

MILWAUKEE SNOW CONVEYOR

This machine, manufactured by the Snow Conveyor Co., will cut a road 9 feet 7 inches wide through light, heavy or packed snow at a speed of 1 to 10 miles per hour, maintaining an average of 6 miles for ordinary conditions. On concrete roads it makes a clean sweep and on dirt roads can be regulated to leave a blanket of snow of from 1 to 10 inches in depth. At high speed the conveyer can travel 1,800 feet per minute, throwing snow 10 to 40 feet to the side of the highway, according to wind resistance.

The machine is 16 feet long, 9 feet 7 inches wide and 9 feet high over all, weighs 9,500 pounds, has a 50 h. p. motor and a 28-gallon tank.

INDUSTRIAL NOTES

THE SANITARY CITY

The Way-cleanse Corp., bulletin is devoted to the gas-electric suction street sweeper, emphasizing the necessity of removing germs contained in dust from the city streets and the vast amount collected by this vacuum sweeper which has a combination gas and electric drive and straight mechanical device giving a wide range of vehicle speed and various speeds for the broom, blower, and auxillary motors, with simplified controls. The machines travel at from 2 to 6 miles per hour, separating the dust so effectively that none whatever is in evidence while the streets are being swept. The machines are climbing the steepest grade in Sandusky without stalling. One machine removed more than 8,000 pounds of litter, sand and fine flour-like dust from about 27,000 square yards of pavement after the latter had been cleaned on the same day by the old city methods. St. Louis is now using four Way-cleanse machines and wants 16 more, sufficient to handle 50,000,000 pounds of street dust annually.

THEORETICAL AND PRACTICAL CO-ORDINATION

The Kissel Motor Car Company issues a bulletin showing how the Kissel Engineering Service is increasing road building efficiency by means of its road division and engineering organizations to design and manufacture road building trucks and equipment. They have originated and developed exclusive features to eliminate loss of time and labor by tables used for the construction of properly designed aggregate transportation, material handling, truck turntables and aggregate hopper with multiple measuring gate for rapidly loading batch boxes and compartment trucks.

The special trucks and truck turntables used for the construction of five miles of 18-foot concrete road at Watertown, Wisc. enabled the contractor to handle a bucket of material to storage bin every 35 seconds, charge 9 measuring boxes every 12 seconds; load a 3-box truck in 25 seconds, reverse the truck on the turntable in 10 seconds; haul the load at a speed of 30 miles per hour; and dump the three batches into the mixing machine skip in 4 minutes.

HEIL COMPANY GOOD ROADS EXHIBIT

The exhibit of the Heil Co. at the Chicago Good Roads Show displayed a larger number of truck bodies and hoists than were shown by any other manufacturer. They included hoists mounted on Atterbury, Mack, Parker, Harvey, Stoughton, Indiana, Kissel, F. W. D., and Republic trucks, and received many orders from contractors throughout the country. Much attention was attracted by a miniature truck 6 feet long built to a scale of 1:3. It was complete in every detail, beautifully finished and operated perfectly. It was mounted on an ordinary table, making it very convenient to examine the mechanism and particularly to observe the operations of the hoisting and dump-device.

The exhibit also included samples of the Heil gravity dump body with a hand hoist on a convenient bench, and a large album or swinging racks for photographs of Heil trucks in service.

A specially interesting feature of the exhibit was the Heil swinging truck body partition that is claimed to be the most simple one on the market, and when raised swings open.

RATHBUN GAS ENGINES

The Rathbun Jones Engineering Co. has appointed the Ingersoll-Rand Co., New York, general sales agent for Rathbun gas engines. Rathbun gas engines have been in successive operation for over 20 years. They are of the verticle, multi-cylinder type and are built to operate on natural, illuminating, producer, coke oven, oil still and other forms of gases which can be successfully handled in an internal combustion engine. Sizes range from 100-brake horse power to 1,450-brake horse power.

OPENS BRANCH OFFICE AT ALBANY

In line with its recent action in opening branch offices at Raleigh, N. C., with Harry P. Grier in charge, and at Atlanta, Ga., with James R. Valk in charge, the Asphalt Association, J. E. Pennybacker, secretary, carrying out its policy of expansion, has moved its Canadian office from Toronto to Albany, N. Y., where Germain P. Graham, formerly deputy city engineer of Albany, will be in charge as district engineer.

NEWS OF THE SOCIETIES

CALENDAR

March. 1-3—ONTARIO GOOD ROADS ASSOCIATION. Toronto.

Mar. 14-16—AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual convention. Chicago, Ill.

Mar. 15—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Mar. 18—ROCHESTER ENGINEERING SOCIETY. Quarter-centennial dinner.

Mar. 23-24—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting. Urbana, Ill.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting, Chicago, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19 — AMERICAN WATER-WORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

AMERICAN ASSOCIATION OF ENGINEERS

A special bulletin reviewing the work accomplished by the Association during 1921, called attention to a number of important activities.

It held the first national conference on engineering publicity and secured more than 300 columns of newspaper display.

It liberally supported a reorganization of the department of the government on a basis of greater efficiency. It advocated the appointment of an engineer to the Interstate Commerce Commission. Through its Federal office, railroad section and many chapters it worked to prevent reduction of salaries of government railroad engineers, co-operated on the reclassification bill and has now a committee working on a salary of engineer service.

The association has successfully contested with several corporations releasing engineer employees with less than two weeks notice. It maintained an effective employment service which has sent out notices of more than 6,000 positions open and has placed more than 3,000 men. The committee is now making plans for a national employment service adequately financed.

Ethical standards have been promoted by the practice committee, which has passed upon ten important cases which has brought the enactment of license laws in several states to protect competent engineers and require those who wish to practice to be properly examined and registered.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The annual report of the Board of Direction, showed a total membership of 10,342, being an increase of 435 over last year. During 1921 the society lost 90 members by death and gained 743 by election. The library gained 2,429 volumes by accession, making a total of more than 157,530 volumes, maps and plans, and had an average daily attendance of 83. It made 332 searches and copies of searches and expended about $27,000. The reading room had an attendance of 5,051, being an increase of about 23 per cent. over the year 1920.

The society has co-operated its management and shared in the expense of the employment service maintained by the Federated American Engineers' Societies, by which 1,905 men were registered and 1,365 were placed. The net expenditure for publication in 1921 was $67,510.22. The society has 34 local sections, seven of which were organized during the past year. It has 39 student chapters, of which 31 were organized during the past year.

In spite of general economical depression and a large amount of unemployment among engineers, the financial conditions of the society have continued to improve, and there is a balance on hand of $40,906.23 remaining after the year's expenditure of $260,730.27. The total assets of the society are inventoried at $1,252,597.05, with a surplus of $963,658.03; the receipts during 1921 were $259,982.55.

LEHIGH VALLEY SECTION, A.S.M.E.

The Lehigh Valley Section of the American Society of Mechanical Engineers at its meeting at Bethlem on February 8th was addressed by Col. H. C. Boyden on "Recent Developments in Manufacturing of Cement," and Walter Cassia on "Placing Concrete." The subject of the meeting was "Cement and Concrete."

DETROIT SECTION, A.S.M.E.

The Detroit Section of the American Society of Mechanical Engineers held a meeting on February 17th. This was at the same time the sixth joint meeting of the Associated Technical Societies at Detroit. The American Society of Civil Engineers and American Society of Military Engineers were in charge of the program, which included an address by Col. J. G. Vincent on "The Trend of Aviation."

ENGINEERS' DINNER

The thirteenth annual dinner for engineers of Boston and vicinity was held on February 7th at the Boston City Club. The following societies participated: the American Society of Civil Engineers, the Engineers' Club, the Illuminating Engineering Society, the New England Water Works' Association, the Plant Engineers' Club and the American Society of Heating and Ventilating Engineers. Col. Charles R. Gow was toastmaster; and the speakers were A. Lawrence Lowell, president of Harvard University, on "The Conference on the Limitation of Armaments" and Philip Cabot, on "The Engineer's Opportunity."

KANSAS ENGINEERING SOCIETY

The February 8th meeting of the Kansas Engineering Society was addressed by President Mortimer E. Cooley of the Federated Engineering Societies.

KANSAS ENGINEERING SOCIETY

At the meeting of the Kansas Engineering Society on December 22nd and 23rd, the following officers were elected: president, Lloyd B. Smith; vice-president, P. L. Brockway; secretary-treasurer, J. M. Averill; and directors P. J. Ruckel and H. B. Walker.

PERSONALS

Coughlin, George M., has recently been chosen director of public works of Bridgeport, Conn., to succeed Jack A. Courtade.

Holmes, Harold R., city engineer and building inspector of Lockport, N. Y. has been reappointed.

Prouty, Leslie E., has been appointed county engineer of Mobile county, Ala., to succeed S. M. Adams.

Batchelder, George W., water commissioner of Worcester, Mass., has been re-elected by the common council.

Shawyer, Casper D., has been appointed city engineer of Cheyenne, Wyo.

King, Clifford M., assistant engineer in the sanitary department of the city engineer's office at Cleveland, Ohio, died on January 2nd.

Myers, Harry, has been appointed city engineer of Pittston, Pa.

H. O. Garman has entered private practice in consulting engineering and the management and operation of public utilities with offices in Indianapolis, Indiana. For more than fourteen years Mr. Garman was chief engineer of the Public Service Commission and the Railroad Commission of Indiana, serving under five governors. During this time he valued many hundreds of Indiana properties totaling more than $300,000,000. Mr. Garman is national president of the American Association of Engineers.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 March 4, 1922 No. 9

Activated Sludge Sewage Disposal Plant at Gastonia, N. C.

By Fred W. Simonds

Design and operation of a plant that contains some novel features. Sludge treated with sulphur dioxide and pressed.

There has just been completed and put into operation in Gastonia, North Carolina, an activated sludge sewage disposal plant of a novel and interesting design.

The plant was designed in 1918 but the war conditions delayed its construction until Sept. 27th, 1920, when a contract was signed and construction immediately started.

The plant was first put into operation Oct. 18th, 1921, for the purpose of building up a highly activated sludge of sufficient quality by a continuous circulation and aeration of a single dose of sewage. On December 14th, 1921, or about eight weeks later, the entire plant was in operation, including dewatering apparatus and sludge press.

The plant is located on a tract of about 80 acres owned by the city and located about two miles southerly from the center of town.

In general, it consists of four aerating tank units each 66 feet long, 8 feet 6 inches wide and an average of 11 feet 2 inches deep, and four settling basins each 30 feet long by 8 feet 6 inches wide and with a varying depth and a hopper at lower end as shown on the plans. The plant over all is 40 feet by 101 feet. Two 15-inch terra cotta main outfalls bring the raw sewage from town into a manhole near the plant. The level of the sewage as it comes into the collecting manhole alongside the plant is about six feet below the level of sewage as it is maintained in the plant. It is lifted by a simple form of air jet—a piece of 2 1-2-inch brass pipe about two feet long, capped at the bottom and with 1500 1-16-inch holes drilled through its side.

The sewage is lifted to a point about three feet above the top of the plant proper and passed down into and through the sides of two vertical bar basket screens 21 in. square and 28 in. deep. These screens are made up of galvanized iron cross arm braces spaced ¼-inch apart by ordinary galvanized iron washers and held together by means of 1-2-inch by 20-inch galvanized steel bolts. These baskets have no bottom but in place thereof are two 18-inch by 18-inch sluice gates laid horizontal and manually operated. When a screen becomes clogged, the operator diverts the sewage into the other screen, runs a wheelbarrow underneath the former, opens the sluice gate and the refuse drops down out of the basket into it. These screenings are then hauled away and buried.

The sewage flows from these screen baskets into a trough about 18 inches wide and averaging 20 inches deep. The trough extends all around the aerating tanks. At each end of each tank unit there are two 8-inch special outlet valves through the bottom of the trough by means of which sewage can be led into any or all of the tanks and they may be operated in series or parallel or as may be deemed best by the operator. These outlets being in the bottom of the trough preclude any possibility of putrescible matter lodging in the trough, as might occur with side outlets. These outlets can be closed by a disc properly fitting into the opening and with a D handle for lifting out.

In the bottom of each aerating tank there are two rows, longitudinally of the tank, of filtros plates, 448 being used in the entire plant. The containers for these are made of cast iron and hold four plates each. They are made in two horizontal sections and grouted and bolted together after the filtros plates have been placed therein. These special cast-iron containers were heated and dipped in hot asphalt and then the bottom section was lined with No. 22 gage aluminum plate properly shaped. Air pipes ½ inch to 4 inches in size lead air from an 8-inch air manifold running transversely of the plant into these cast iron containers below the filtros

plates. A bleeder line is also led from each container to the top of the plant, there terminating in an ordinary gas cock. These containers are laid end to end and grouted in place. Between the rows of plates and against the sides of the tank, ridges of concrete are formed so that any falling sewage is diverted to the surface of the plates. The filtros plates are 12 by 12 by 1 1-2 inch Grade S plates, furnished by the General Filtration Company of Rochester, N. Y.

Air for the diffuser plates and for the air jets is furnished by Nash 6 "Hytor" air compressors furnished by the Nash Engineering Company of South Norwalk, Conn. These units are rated at 935 cubic feet of free air per minute against ten pounds pressure and are in duplicate.

When it becomes necessary for any reason to empty an aerating tank unit, the inlet trough valves are closed, excluding the sewage from this unit, and the air jet in the drain manhole is started, lifting all the sewage out of the tank into the pipe leading to the inlet manhole and thence through the other three units in regular form.

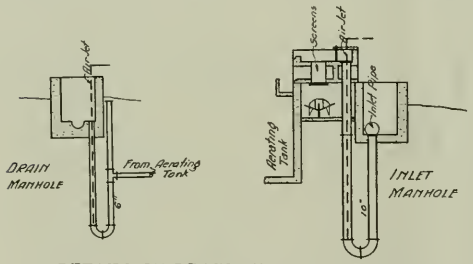
After sewage has been aerated and agitated in the aeration tanks, it passes through the bottom of the outlet troughs and into the troughs over the settling basin, from which it drops through special valves, similar to those in other troughs, into the the settling basin, where the sludge slowly settles down. A large portion of this sludge settles at once into the hopper directly underneath. These hoppers are like an inverted pyramid 8 feet 6 inches square and 6 feet deep. The floor of the other portion of the tank has a slope of two feet toward the hopper. A traveling wood flight conveyor, as shown on sketch, made up of two link belt chains per unit and carrying wood flights, travels at the rate of six feet per minute along the floor of the basin toward the hopper thus acting as a squeegee to carry the sludge which has settled in this portion of the tank into the hopper.

The effluent of this tank passes in a thin film over brass weirs into the outlet trough and thence to the stream. This effluent is clear and carries no solids at all.

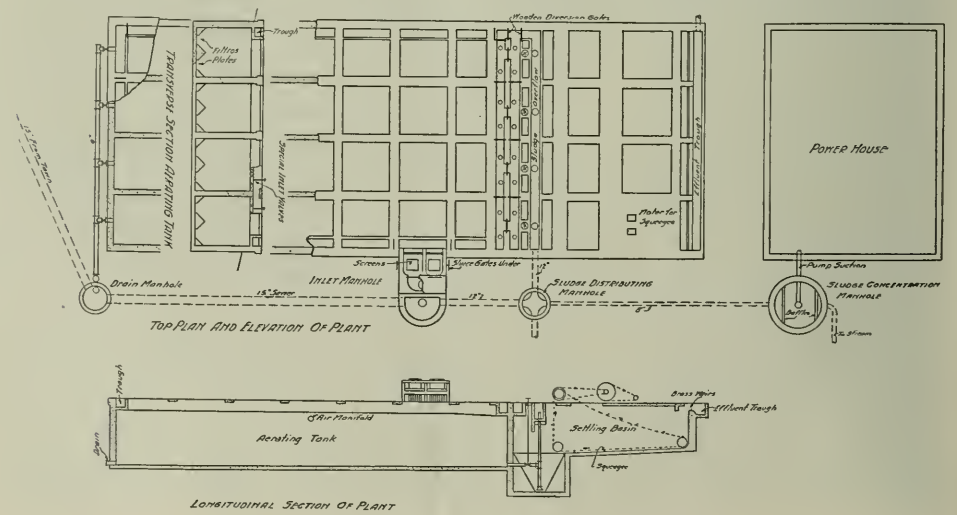
The sludge which has settled in the hoppers, being about 98 per cent water, rises through bell mouths and vertical riser pipes into the sludge overflow trough. The tops of these pipes are movable so that the top can be set at any desired height below the weirs at outlet for best results. This varies with quantity and quality of sludge being handled and is adjusted from time to time to get a good effluent and satisfactory sludge.

The sludge is led from this trough into a "sludge distributing manhole" outside the plant proper. This manhole is four feet in diameter and three feet deep and is for the purpose of distribution only. Part of the sludge is diverted back to the inlet manhole to go through the plant again, while part is taken to a sludge concentration manhole for pressing. An outlet is also provided in this manhole for leading sludge into a possible sludge drying bed in summer months.

At the present the best results are being obtained by holding down the sludge content of aerating tank to 35 per cent after 15 minutes settling of sample. This is obtained by taking frequent test



DETAILS OF DRAIN AND INLET MANHOLES.



PLAN AND SECTIONS OF ACTIVATED SLUDGE PLANT

samples and drawing out sufficient sludge into the concentration manhole to keep the proper ratio in the aerating tank and at the same time obtain a clear effluent. When this plan is properly carried out, no trouble has been experienced by the sludge turning septic.

The sludge that has been diverted into the concentration manhole (which is 8 feet in diameter and 14 feet deep) is here dewatered by forcing sulphur dioxide fumes through it by means of a Connersville blower from a sulphur burner, and after a few minutes' sedimentation additional sludge is admitted to the tank, forcing the supernatant clear liquid to overflow. The new mixture is again gased and the operation repeated until the tank is practically filled with thick sludge.

The process as above outlined is a modification of the MacLachlan process, which uses sulphur dioxide with steam, and was developed by the engineers with the co-operation of the MacLachlan Reduction Process Company, which furnished the equipment.

The sludge, after this treatment, is lifted from the tank by a Goulds 7x10 triplex plunger pump under pressure into a 40-plate 40-inch filter press of the old G. H. Bushnell type. A good cake is now being obtained, and tests will be made at once to develop a satisfactory control. After a pressing has been made, the plates are opened up and the sludge cake falls into a concrete trough beneath the press. In this trough there is a helical conveyor, operated by a motor connected to the shaft by a silent chain drive. This conveyor revolves at a speed of 48 revolutions per minute and carries the cake through the walls of the building into carts outside and thence it is hauled away to other parts of the property and piled up. The conveying apparatus was furnished by the Carbondale Machinery Company of Carbondale, Pa.

The plant at the present time is handling about one million gallons of sewage daily and about 13,000 gals. of sludge is being drawn out for pressing daily, but the press is operated only on alternate days for a period of four hours for a complete operation.

The machinery is housed in a brick power house adjacent to the plant which is 27 feet by 37 feet inside. All machinery is motor driven and consists of the following:

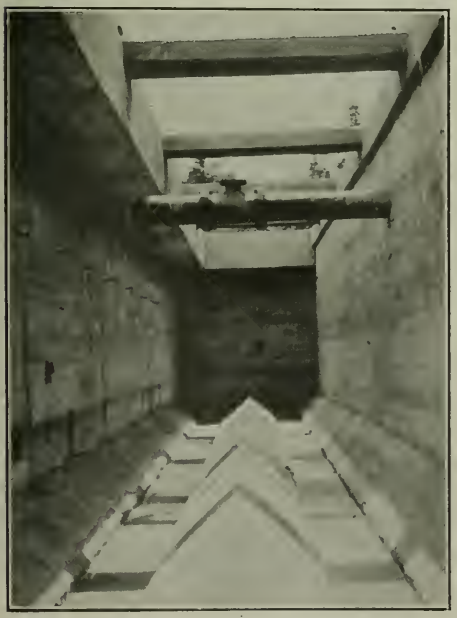
Two Nash air compressors direct connected to a 60 h. p. motor of the slip ring, variable speed type through a Turbo Gear of ratio 4.6 to 1 made by the Poole Engineering and Machinery Company.

One Goulds 7x10 triplex plunger pump direct connected to a 20 h. p. slip ring, variable speed motor.

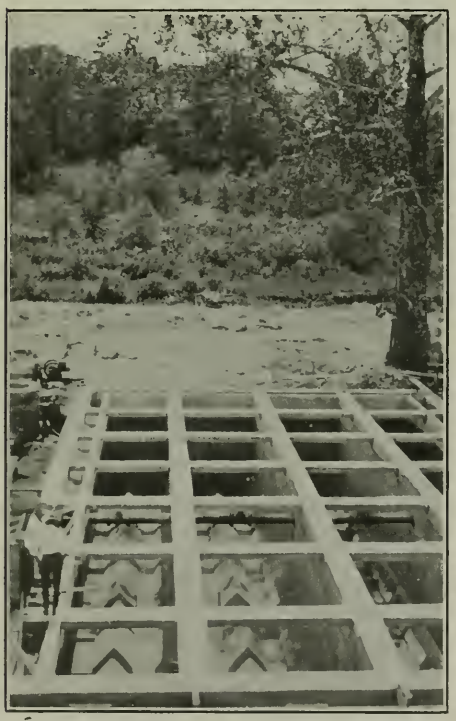
One sulphur burner revolved by a 1-4 h. p. motor through gears.

One Connersville blower for handling sulphur gas, belt-connected to a 7½ h.p. motor. The sludge press also is located in this building.

One 1 1-2-inch Goulds centrifugal pump fur-



VIEW IN AERATING TANK
Shows ridges of concrete and recesses for filtros plate containers. Above is 8-inch air manifold.



AERATING TANK, VIEWED FROM ROOF OF POWER HOUSE.

nishing 50 gallons per minute from a suction in the effluent channel for washing down tank walls, etc.

Outside of the power plant and on the top of the settling tanks is located the motive power for the operation of the link belt squeegee. This is furnished through link belt chains and sprockets by a 5 h. p. motor through a D. O. James speed reducer with an 80 to 1 ratio of reduction.

The plant was designed by William M. Piatt, consulting engineer of Durham N. C. Fred W Simonds was resident engineer in charge of construction. B. W. Harris of Durham, N. C., was the contractor. The electrical work was installed by C. E. Rhyne, superintendent of public works in Gastonia, N. C.

The plant is owned and operated by the municipality, of which W. J. Alexander is city manager.

Paving on the Neenah-Oshkosh Road

A Wisconsin road built by county forces using standard apparatus. Prices using different methods of transporting materials.

The Neenah-Oshkosh Road in Winnebago county, Wisconsin, has aroused a great deal of interest because it was successfully carried on with county forces and with a relatively low investment in machinery. The progress of the work was very good considering the method of handling material to the mixer, the idea being not to revolutionize concrete production with new experiments and record runs, but to efficiently carry out the work with available men and equipment. The equipment is such that it is flexible enough to be used on any work in the county and at the present time there is a surplus of laboring men in that locality, who are afforded employment by road construction.

The season's work consisted of 7.45 miles of road built in two sections. The south section was 4.41 miles long, extending north from the city limits of Oshkosh; the other was 3.04 miles extending south from the city limits of Neenah, both joining last year's construction. Paving operations began May 31 and ended Sept. 17. The shouldering was completed about Oct. 15 and the entire road thrown open to travel. This completed the stretch of concrete road from Oshkosh to Green Bay, a distance of fifty miles.

The grading was done with teams, using No. 2½ Russell wheeled scrapers. The old gravel road crossed fairly level country and it was necessary to lower the profile of the road in order to get enough material for shoulders. The excavation was very light, averaging 2,660 cubic yards per mile. The Eastern Wisconsin Electric Company's interurban tracks paralleled the road. Arrangements were made with the company to haul materials to the highway. When the grading was done care was taken not to leave any excess material next to the car tracks where it would interfere with dumping the aggregates on the subgrade. In these instances it added considerable to the cost of grading to move the earth to one side of the road and to move it back for shoulders after the pavement was completed.

The plans show reference stakes every hundred feet apart but a resident engineer set permanent stakes every twenty-five feet. These were set beyond the ditch line out of danger on each side of the road. The stakes were driven either to exact grade or to an even number of feet above or below grade, depending on the character of the cut or fill. When these stakes were set and properly marked, it was an easy matter to check the grade at any time by means of three sight sticks or Ts. One of these sticks was set on each stake and an adjustable T, set at the proper reading, was held at different points across the road. The fine grading was continued until the subgrade checked within a tenth of a foot at every point. By checking very closely at every twenty-five foot interval there was very little variation of the subgrade anywhere on the road. After the grade had been trimmed to proper shape, great care was taken not to put a crown in the roadbed when subsequent grading was done to fill the ruts.

The 4.41 mile section extending north from Oshkosh was favorably situated to ship material to a siding near the center of the job, from which the material was distributed by the interurban line. The aggregates were transferred by clam shell from the steam line car into twelve-yard dump cars. No stock piling was necessary, as the stock piling was done on the road. Only enough material was piled at the siding to load an emergency car for use at the mixer or to fill out a partially loaded car of sand or gravel.

The cement was hauled by flat car direct to the road. A small shed having a capacity of three cars stored enough cement for any emergency caused by a delay in shipments. An average agreement on demurrage afforded a good means of handling cement direct from the car and resulted in a saving both in handling and demurrage.

A mile of material was spotted before the paver started, so there was no delay after the paving crew was organized.

Two-inch wooden forms were used for side forms. The resident engineer set stakes every fifty feet on the line side for both the alignment and the grade of the top of the forms. The forms on this side were set about 200 feet in advance of the mixer. The other side was set as soon as the piles of material were removed.

The mixer, a five-sack Austin cube paver, was charged with a four-sack or a five-sack batch, depending on the size of crew at work. The mixer skip was loaded by wheelbarrows, two sets being used so that each wheeler dumped his load into every second batch. Each man loaded and wheeled his own barrow. An extra man cleaned up the piles. It was a simple matter to keep track of the wheelers by painting each set of barrows a different color so they were easily distinguished when they were with the wrong set of wheelers.

The finishing was done by hand, using a strike board to strike off and tamp the concrete and a belt

for final finishing. "Elastite" joint material was used every fifty feet. After the pavement had been struck off and before the final finishing was done, the joints were struck off with a six foot notched straight edge which was used in a manner similar to a split float. This one operation was very beneficial in insuring good riding joints. The pavement was covered with earth as soon as it had set sufficiently, and this covering was kept wet for two weeks before it was opened to traffic.

Paving operations on this 4.41 mile section began May 31 and ended July 28. During that time there were fifty days available for paving out of which the paver operated 47; one day's delay was due to rain, the other two were caused by a delay of the Eastern Wisconsin Electric Co. in lowering their tracks. The total amount of pavement laid in that time was 23,272 linear feet of 18 ft. one-course pavement, 7 inches thick on the sides and 8 inches in the center. The mix was in proportion of 1:2:3½. The average day's run was 495 linear feet, and the maximum day's run was 610 linear feet.

Four days were consumed moving to the North section, ten miles distant. Work was begun on this section August 3 and was finished September 17. The pavement was 18 ft. wide, as before, but the mix was 1:2:4. The total amount of pavement poured was 16,069 ft. The average run per day was 459 ft., the maximum 607 ft. Out of the 39 days available, the mixer operated 35. The four days delay were due to rain. There were a number of days when very little progress was made because of the small crew. It was difficult to maintain a full sized crew due to the long distance they were transported to and from work. This section which was 3.04 miles long was not so favorably situated along the interurban line and was for the most part a truck haul. A local stone quarry which was operated by county forces at a point near the center of the job supplied all the coarse aggregate for this section. The sand and cement were shipped to Neenah and hauled to the job by truck.

A comparison of costs between the two sections of this road is interesting in view of the fact that the materials on the south end were shipped to a siding, unloaded and hauled to the job by electric line, and the north end was principally a team or truck hauling proposition and a stone quarry was operated to furnish the coarse aggregate for it.

Summing up all expenses connected with the job, including depreciation of equipment, insurance, compensation, and interest on the investment, the cost per mile of the south section was $26,315. (The records for the north section are not complete.) Paving alone cost $2.10 a square yard on the south section and $1.99 on the north. On the south section culverts cost $19.65 per cubic yard; grading ahead of mixer cost 78.4 cents per cubic yard or $2,066 per mile, and shouldering 49.9 cents per cubic yard or $1,319 per mile.

The costs of the various items, for the south end and north end respectively were: Cement in place, 88.3 cents and 83.4 cents per sq. yd., or $2.59 and $2.55 per bbl. Fine aggregate in place, 27.5 cents and 25.9 cents per sq. yd., or $2.63 and $2.69 per cubic yard. Coarse aggregate in place, 55.5 cts. and 49.9 cts. per sq. yd., or $3.06 and $2.54 per cu. yd. Joint material, 1.2 cts and 0.9 cts. per sq. yd. Mixing and placing, 23.4 cts. and 23.2 cts. per sq. yd. Water supply, 3.5 cts and 2.8 cts. per sq. yd. Sundry costs, 6.1 cts. and 11.4 cts. per sq. yd. Administration, 4.3 cts. and 1.8 cts. per sq. yd.

This is only one of five concrete jobs in the state carried on by day labor crews. Each job is carried on by county management and state supervision. Accurate and thorough cost data are kept of each project to offer a means of studying the relative costs and efficiency of different methods of construction.

Street Work in Toledo

During 1921 the street department of Toledo, Ohio, cleaned the streets by machine brooms, by hand patrol and by flushing. During the year 8 machine sweeping crews were in operation, giving from 10 to 40 cleanings anually to all streets that were on schedule for this kind of cleaning. During the year 29,150 loads were removed by the machine brooms. The hand patrol or white wings method of cleaning is used in the business district and also in residential sections where this class of service is requested. A daily average of 60 men and 5 teams were employed in this service.

In flushing the streets 8 crews operated day and night shifts. Owing to the heavy traffic in the business sections during the day, the streets in this section were flushed three nights a week during the summer months. Approximately 11,000,000 gallons of water were used for this purpose.

In cleaning alleys the department removed 20,187 loads of ashes and rubbish, which is about 15% more than in 1920.

In cleaning catch basins 10 men and 3 single rigs were employed and cleaned 3,000 catch basins during the year.

Of the streets of brick, stone, macadam, asphalt block and wood block, more than 140,000 square yards were repaired, while more than 700,000 square yards of cinder roads and other streets were repaired or patched, in addition to 57,469 square yards of asphalt repairs and resurfacing.

During the year 10,000 new street signs were put in place at a cost of $7,940.

The city garbage was collected by the street department by city-owned teams and hauled to the disposal plant until the contract with that plant was discontinued, after which it was disposed of partly by being plowed under on farms and partly by hauling to the disposal plant. Thirty teams and wagons were used with an average of 60 drivers and helpers and 3 foremen. Dead animals, with the exception of horses and other large animals, were collected by a Chevrolet truck, 3,713 dead animals being collected during the year. The garbage collection totaled 11,843 loads estimated at 2 tons per load.

The department maintains 94 horses and mules for street cleaning and repair and garbage collection, and employed a foreman and 12 men for taking care of these animals and doing the necessary work at the barn and stable. There are also employed a horseshoer, a blacksmith and two help-

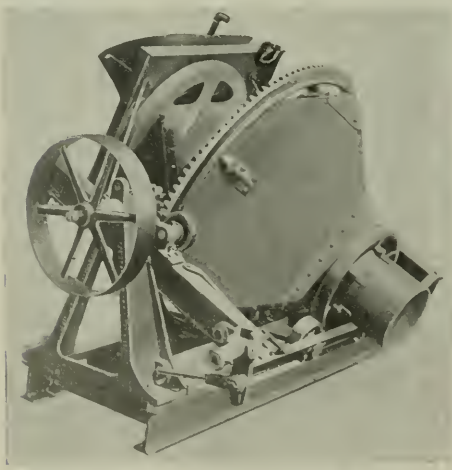
ers, a wagonmaker, two carpenters, two painters and three men with a single rig and horse who make all necessary repairs to pumps and water troughs in the city. Last year the 180 city pumps were repaired 697 times. The blacksmith, carpenters and painters do all the rebuilding and repairing work on the wagons, street sprinklers, flushers, white wing carts and other vehicles, tools and implements.

Cube Mixers

In an article which appeared a few weeks ago in PUBLIC WORKS it was stated that cube mixers were not charged or discharged while in motion, but were stopped for each of these operations. This statement was noticed by an official of the company that manufactures the Austin cube mixer and he has written to inform us that as a matter of fact there is no necessity for stopping or slowing up the mixer made by them for either charging or discharging. The operation of this mixer may be described as follows:

The cube hopper and the ring gear fastened to it, together with the discharging spout and the charging hopper, are all mounted on a tilting frame. The cube revolves in this frame and the discharge spout is permanently attached to and revolves with it. The charging hopper, however, is attached to the frame and does not revolve. An opening in one end of the cube, concentric with the axis of revolution of the cube, is directly opposite an opening in the charging hopper, the cube and the hopper at this opening being continually in contact throughout the circumference, so that all material placed in the hopper passes through the opening into the cube. It can be seen that the discharge of the hopper into the cube is not affected by any motion of the cube, either revolving on its axis or moving as the tilting frame is tilted. Only two revolutions occupying from 6 to 8 seconds are required to discharge the entire batch.

Before the cube is tilted, the direction of travel of the batch is always toward and past the center line in a zigzag course, from one plane of the cube to the other. After the tilting of the cube, the direction of travel of the batch is always toward and through the discharge aperture, each of the cube's planes being tilted in that direction as the cube revolves. The illustration shows a small cube in the tilted position with the driving pinion and ring gear in mesh.



CUBE MIXER TILTED FOR DUMPING.

Highway Maintenance Truck for Kern County

By Charles W. Geiger

Carries very complete equipment for road maintenance work.

The accompanying photos show a novel highway maintenance truck recently placed in operation by the Board of Supervisors of Kern county, Calif., for general road maintenance and other highway work on road district No. 4.

Stanley Able, chairman of the Board of Supervisors of Kern county, was partly responsible for the development of this idea, which was developed and the truck designed and built by the Fageol Motors Company of Oakland, Calif. Following is a description of the equipment:

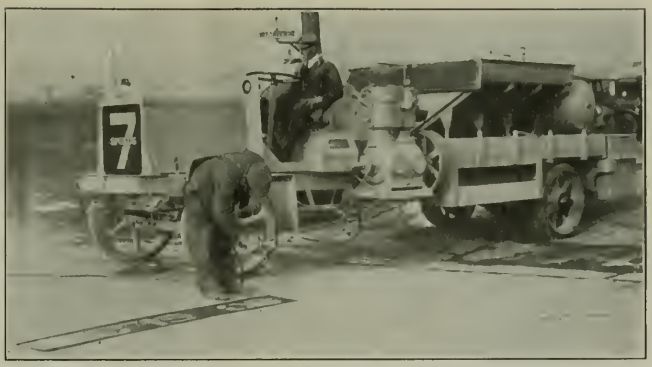
Chassis: Fageol heavy duty, fitted with 4-cylinder, 4½ in.x6¼ in. motor, S. A. E. rating 32.4 H. P., actual 45 H. P. at 1,000 r.p.m

Equipment: (1) Cab, windshield, and storm curtains; (2) air compressor Rix. 6 in.x6 in. twin cylinder, oper-

USING POST-HOLE AUGER.

MIXING AND PLACING CONCRETE.

ated by belt from forward drive shaft, capacity 80-cu. ft. per minute; (3) large air receiver fitted with safety valve, gauge, hose connection; (4) 200 feet 1-in. air hose and connections; (5) combination material bins, capacity 1,000 lbs. cement, 1 cu. yd. sand, 2 cu. yds. gravel or rock, gravity feed from all bins, controlled by hand operated gates, to mixing apron; (6) water tank, capacity 150 gallons, contents can be withdrawn by gravity or under pressure; (7) rotary concrete mixer driven by auxiliary shaft from transmission; (8) centrifugal pump with self-priming device and suction hose for filling water tank from wells, rivers, etc.—this can also be used to good advantage in pumping out caissons in sewer or bridge construction, relieving flooded highways, and for other uses; (9) draw bar attachment for hauling trailers; (10) power driven nigger-head winch; (11) tar or road oil heating tank with gas burners, capacity 50 gallons; (12) Syphon nozzle for spraying hot tar or oil under pressure, with hose; (13) complete paint spray outfit, with hose and connections; (14) large pneumatic jack hammer, with assorted chisels, tampers, etc; (15) pneumatic rotary post hole digger and hose; (16) extension side arm or boom from front end of truck for grading, etc.; (17) large grading plow to be pulled by side arm; (18) drag or grader for shouldering up; (19) steel wheelbarrow; (20) one ten-ton jack and bracket for same; (21) 200 feet 1-in. Manila rope; (22) 25 feet tow chain; (23) steel stencil for lettering highways; (24) hand tools —three shovels, two picks, one large sledge, two crowbars, etc.; (25) ten red lanterns, ten "at work" signs, ten red flags.



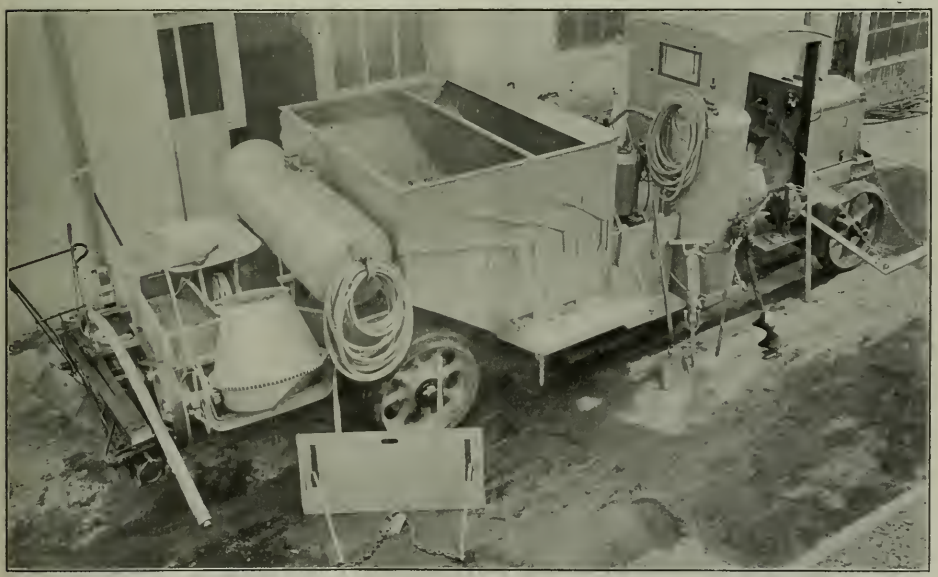
STENCILING TRAFFIC SIGN ON PAVEMENT.

The work that this outfit is designed to perform comprises:

1. Repairing ruptures or breaks in reinforced or plain concrete, macadam or other forms of streets, highways or roads. Using pneumatic jackhammers to break up the damaged places, pneumatic air jet to blow out refuse materials from material bins, mixing same in power-driven concrete mixer, spreading tar or surface oil over new work.

2. Erecting fences along highways or erecting county or traffic signs. Using pneumatic post-hole digger, materials and concrete mixer to set in concrete, tamping tool, paint spray outfit for painting or waterproofing. Side arm can be used for stretching wire. Wooden fences on grades or dangerous curves can be painted with spray outfit.

3. Erecting or repairing steel, wooden or concrete bridges or culverts. Using drawbar attachment to haul materials on trailers. Removing old



GENERAL VIEW OF MAINTENANCE TRUCK.

paint, rust, etc., from steel work with sand blast outfit and repainting with paint spray equipment. Heating and driving rivets with rivet heater and pneumatic guns. Cutting or welding damaged steel work or metal culverts with oxy-acetylene outfit.

4. Beveling, grading, shouldering up, rolling or draining right of way along highways can be done by use of the grading plow attached to the extension side arm, also using the grader and steel roller tire on rear wheel.

5. Stenciling traffic or ordinance signs on streets or highways, using the special steel stencils made for that purpose, with the spray outfit.

6. Chipping out cracks on concrete highways with chipping gun and sealing the openings with hot tar through pressure nozzle.

7. Cutting asphalt pavement with pneumatic chisels or jackhammer when excavating for sewer pipes, underground conduits, etc. Excavations can be properly tamped by tools provided and surface of street covered with asphaltum and rolled. Tar tank can be used to keep asphaltum hot.

8. Spraying trees and shrubbery in parks, streets and along highways, using water tank filled with fungicide and high-pressure fog guns with air hose.

9. Putting out fires along highways, especially grain fires, which burn down fencing, using tank filled with chemical and high pressure through special nozzle. Speed of this unit in overgear makes it practical as an auxiliary fire-fighting apparatus.

A few weeks ago a demonstration was made at the Pittsburgh test highway, where repairs were made to the concrete track.

Mixing and Placing 50,000 Yards of Concrete

Aggregate delivered to elevated storage bins by belt and bucket conveyors, mixed in two separate plants, hoisted, rehoisted and spouted a maximum distance of 610 feet, covering 15 acres of construction area.

The selection, arrangement and installation of a large equipment of high-class concrete plant for the construction of an unusually large factory unit for the Fisher Body Ohio Co., Cleveland, by the Thompson-Starrett Co., New York, enabled a great quantity of urgent construction to be done with unusual rapidity under adverse conditions. The very liberal provision of high-class equipment and the skillful methods, arrangements and operations secured results that were considered to fully justify the large expenditure by the prompt completion of the urgent work within the specified time with a great reduction of hand labor and with a high percentage of salvage to be credited to the job on the completion of the work. Interest charges, heavy overhead expenses, and the possibility of complications and delays were all minimized by the policy pursued. Although the results were obtained in building construction, the principle governing the work and the important features of the plant and operations are of general interest on account of their applicability in large part, or through modification and combinations, to many large construction jobs, such as power houses, dams, filter plants, reservoirs and the like.

The work involved the mixing and placing of 50,000 yards of concrete in heavy foundations, walls, columns and floor slabs, occupying a 15-acre area with maximum dimensions of 1150x710 feet, which notwithstanding unexpected delays and unusual difficulties was accomplished within the limited specified time, about 95 percent of the concrete being placed in one hundred days.

The main building consisted of a six-story 1150x72 foot portion with one two-story 710x302-foot wing, and one one-story 462x253-foot wing, besides which there was a 96x115-foot power house.

SPECIAL CAR EQUIPMENT

After the contract had been signed great difficulty was experienced in securing railroad cars for transporting cement and aggregate and many other contractors in this region were subjected to very long delays; but the Thompson-Starrett Co., in order to execute the work within the specified time, proceeded to purchase outright 25 box cars and 48 100,000-pound gondola cars which they handled with a 60-ton leased locomotive, delivering aggregate and cement to two independent central mixing plants.

HANDLING AGGREGATE

At one of these plants the stone and sand were dumped into track hoppers and thence hoisted by bucket conveyors to an overhead storage bin with a capacity of 250 cubic yards each of sand and stone. The other mixing plant was served by overhead bins with a capacity for 125 yards of sand and 250 yards of stone, which were filled by a belt conveyor 350 feet long and 24 inches wide that delivered sand or stone at the rate of 300 tons per hour, unloading a car in 10 or 11 minutes; the same conveyor also handled the cement bags, distributing the different materials to their respective bins by means of a three-way arrangement at the top of the belt.

MIXING AND DISTRIBUTING CONCRETE

Each of the mixing plants was equipped with a one-yard Smith mixer, electrically driven. The mixers were provided with power tilting devices and with automatic water measuring tanks. At each plant the mixing machine delivered to a bucket of 36-cubic feet capacity which was hoisted by a 100 h.p. single-drum electric Lidgerwood or Thomas machine having a capacity of 6,000 pounds on a single line and a speed of 400 feet per minute. The hoist buckets

were dumped into either of two receiving hoppers of 54-cubic feet capacity which were set at different heights in Insley steel towers, the tower for the No. 1 mixer being 160 feet high and that for the No. 2 mixer being 200 feet.

The No. 1 mixer distributed concrete over a radius of about 130 feet by means of a counterweighted truss and chute and also spouted concrete through chutes 260, 280 and 350 feet in length to the bottoms of steel relay towers respectively 150 feet, 160 feet and 80 feet in height, whence the concrete was distributed by standard Insley quickshift counterweight chute, boom plant and tripod equipments, with 130-foot pouring radius. The No. 2 plant delivered from the hoisting tower through the 290-foot chute to a loading hopper and through two 400-foot chutes to the bottom of relay towers, each 160 feet high, which like the main hoisting tower, were each provided with a counterweight chute and boom plant, giving a 130-foot pouring radius with no intermediate support except a light tripod suspended from the point of the counterweight chute. This installation handled concrete through an extreme construction distance of 2,500 feet and placed 38,000 yards of concrete in addition to 12,000 yards that were mixed by two 1/2-yard portable machines, used chiefly for preliminary foundation work.*

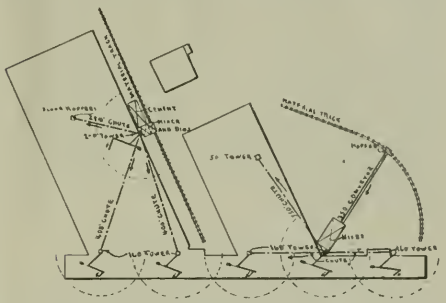
The record output for one day for the two large machines was 1,065 cubic yards of concrete mixed in 17 hours, one machine being operated 9 hours and other 8 hours and producing an average of more than 61 yards of concrete per machine per hour. The greatest distance to which the concrete was spouted from the mixer was about 610 feet horizontally. A force of 16 men spreading and placing concrete at the end of each chute placed a maximum of 360 linear feet of floor 72 feet wide in one day and both plants operating together concreted one complete story in eight days.

MATERIALS AND EQUIPMENT

The form lumber was cut with six portable gasoline-driven saw rigs, and 50 carpenters were employed in making and shifting the two sets of forms. The aggregate was handled, concrete mixed and distributed by a total force of about 60 men, including 12 who were unloading and handling cement.

The concrete was reinforced with about 3,000 tons of steel rods bent at the site and hoisted by self unloading apparatus. The work required about 400,000 cement bags, which were emptied by hand, shaken by electrically driven rotary machines and were baled in two Faeberhill bag bundling machines. The total cost of the construction work was about $4,000,000, the concrete work forming about 25 percent of the whole cost. The maximum force employed was 1,800 men. The maximum force of carpenters employed at any one time was 275. Besides the hoisting engines in the steel concrete towers, seven other hoisting engines were installed to operate the brick and steel elevators and a total of 1,650 electric h.p. was installed to operate the different construction machines.

*These towers are shown in the illustration on the front cover.



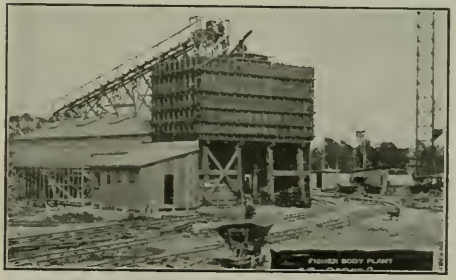
LOCATION OF HOISTING AND REHOISTING TOWERS AND CHUTES

A graphic record of progress was kept. On diagram plans the areas backfilled and leveled were indicated by dotted outlines, excavated areas by solid outlines, forms started by rectangles with one diagonal, forms completed by rectangles with two diagonals, concreted mats by single hatched areas, and completed concrete footings, walls and floors by solid black areas. These diagrams were posted daily and enabled the condition and progress of any portion of the work to be instantly determined by inspection.

Typhoid Attributed to Fish and Shell Fish

Dr. W. H. Hamer, medical officer of health to London county, England, is the author of two articles which have recently appeared, one in the annual report of the London county council and the other in "Public Health" for December 1921, in both of which he discusses at some length the typhoid fever statistics for London. In the report he states that he does not believe present available data in both England and the United States

UNLOADING CRUSHED STONE TO STORAGE PILE



STORAGE FOR AGGREGATES AND CEMENT HOUSE

warrant the belief that preventive inoculation has caused a lower incidence upon young men during the war, and further that London experience for 25 years past furnishes no clear evidence of the spread of typhoid due to direct case-to-case infection. From a review of the London outbreaks, which he discusses at some length and especially the epidemiologic data, he inclines to the belief that fish and shell fish have been responsible for the greater part of the typhoid outbreaks in London during the past 25 years and that the continued and accelerated fall of typhoid in London is to be attributed mainly to the improved conditions surrounding the supplies of fish and shell fish furnished to that city.

Competitive Plans for "Moving Platform" Transportation

The City of Paris is inviting inventors to submit plans for a "mechanical system of continuously operating conveyance for passengers." No special route is designated, but the general design only will be considered. The inventors must, however, give suggestions as to arrangement of stations, elevator, escalators, connections with the existing subway, etc.

Three prizes are offered—100,000 francs, 50,000 francs and 30,000 francs. The jury will be free to award these separately or combined.

The plans will remain the property of the inventors and the city does not guarantee to carry them out. If, however, the city should decide to construct such a system, it can, if no other arrangement is made with the inventor, acquire full ownership for 500,000 francs.

The competition is open to all until September 20th, 1922, at 6 p. m. Competitors must make a deposit of 100 francs, which will be returned to those who satisfy the conditions of the competition.

For further information, address "Service Technique du Metropolitain, 48 Rue de Rivoli, Paris, France."

New York-New Jersey Tunnel

The second bidding for the river section of the vehicular tunnel from New York to Jersey City resulted February 15 in the award of three contracts aggregating $19,250,000 to Booth & Flynn, who expect to begin work quickly and complete it within 36 months. The bid was made in competition with two others, one for $1,410,000 more than the successful bid and one for $22,291,000, presented by the P. McGovern Co., Inc., and by Holbrook, Cabot & Rollins, associated with the Keystone State Engineering Co., respectively.

The successful bidder gives a surety bond of about $4,000,000, a requirement that caused some difficulty at the previous bidding for the same work when the present successful bidders submitted a bid $500,000 greater than their last bid. The difference in the last bidding between the highest and lowest bid amounted to only about 15 per cent. and the results of the letting are considered very satisfactory by the officials, in that it secured bids from three experienced firms of high standing and obtained a figure much smaller than had been previously offered and considerably below the official estimate of cost, a fact that is probably due to confidence in the continued decrease of labor and material cost, which have fallen materially since the first estimates were made.

The work will be done by the compressed air and shield method with cast iron lining, similiar to that employed for the Rapid Transit and Pennsylvania Railroad tunnels already built under the East and North rivers.

The contract is said to be the largest ever entered into by the State of New York and covers the larger part of the vehicular scheme, which with its shaft and approaches will, it is now expected, be built within the estimates of $28,669,000.

The contractor, who is now completing the large twin Liberty tunnel in Pittsburgh, previously built six subway tunnels under the East river, the last of these contracts being for four tubes, aggregating $12,500,000.

Brooklyn-Richmond Freight and Passenger Tunnels

In a recent communication to the mayor of New York, the chief engineer of the Board of Estimate and Apportionment, the Commisioners of Docks and of Plants and Structure, and the engineer of the Borough of Richmond transmitted a report of consulting engineer W. J. Wilgus as a review of the subject from every angle and as setting forth the status of the project at the present time.

Mr. Wilgus treated the subject under the heads of: necessity of a meeting; authority for comprehensive plans of the meeting; the Narrows Tunnel preferable to the Port Authority plan; estimated saving; and justifiability of the project. From these investigations he concluded that there is a crying need for relief from the present method of freight transportation between the trunk lines and the eastern shore of the harbor of New York.

There are in existence two New York State laws to provide that this relief shall be given, one through the agency of the New York Port Authority and the other through the instrumentality of the Board of Estimate and Apportionment of the City of New York, which is required to build a freight and passenger tunnel beneath the Narrows, between the Boroughs of Richmond and Brooklyn.

He concluded that the preferable solution of the problem affording relief under these two laws is that under the provision of the Narrows tunnel act, which minimizes fixed charges, avoids centers of congestion in New Jersey, obviates grade crossings of water and rail traffic and draw bridges, has very moderate gradients on steam operated sections, provides a clearing yard for classification of cars, minimizes traffic development of adjoining territory and leads mainline traffic to the Borough of Richmond, where the best of service could be afforded by great ocean piers on the North Shore and on Arthur Kill. That the immediate construction of the Narrows tunnel is justified, and that the carriers jointly should negotiate with the city of New York as to the terms under which the Narrows tunnel plan may be made effective.

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A Small Activated Sludge Plant

A city of 15,000 or less population in North Carolina has recently put into service an activated sludge plant which contains not only the air compressing and pumping machinery required for supplying air and returning the activated sludge, but also a sulphur burner and a blower for applying sulphur dioxide to the sludge and a sludge press for reducing the water content, and a motor-operated appliance for forcing the sludge to the outlets of the settling tanks. This plant is described in this issue.

Such abundant provision of machinery is found in a number of the larger sewage treatment plants, but is uncommon in those with a capacity of only two million gallons a day. In fact, some engineers would consider that the activated sludge process, with its requirement of machinery and constant attention, is suitable only for large cities. Apparently the engineers and others in charge of Gastonia's public works believe that added efficiency and saving in labor can be secured by this mechanism which make it worth while.

The sludge cake produced is quite firm and can be handled in quite large pieces. Whether the farmers will take it for fertilizer or it will be used for filling low land remains to be seen. The plant has been operating completely only about two months and the adjustment of the various operations to the most satisfactory operation of the plant as a whole is still being studied by the engineers. At present only about thirteen thousand gallons of sludge is drawn out daily for pressing and the press is operated only about an average of two hours a day. The plant is located a mile or more outside the city limits on an eighty-acre tract owned by the city, and presumably the disposal of the sludge will not present a very serious problem for some years, even if the sludge is not utilized for fertilizing purposes.

Because of the several novel features of this plant, engineers will follow its future operations and development with a great deal of interest.

Shellfish and Typhoid

For years students of typhoid epidemiology have felt quite sure that a certain amount of typhoid fever was due to oysters and other shellfish that had spent some time in sewage-polluted water. It is generally considered, however, that the number of cases attributable to this cause is relatively small.

It therefore arouses some interest to learn that the medical health officer of London announces his belief that the greater part of the typhoid outbreaks in London during the past twenty-five years have been due to fish and shellfish. Oysters are not the chief form of shellfish consumed in England, as they are in this country, but the general chain of acts and conditions connected with the securing, handling, selling and consumption of the various kinds of shellfish are presumably similar in both countries.

Certainly a similar conclusion could not be arrived at in this country. To cite only one proof to the contrary, the filtering of water supplies has been followed so invariably and immediately by a reduction of 50 to 90 per cent. in the typhoid death rate that there can be no escaping the conclusion that a very large part of the typhoid in this country in past years has been due to polluted water.

With water largely eliminated by purification, however, sanitarians can concentrate their investigation upon other causes, and in doing so will undoubtedly give due attention to oysters and other shell fish.

Disproportionate Material and Transportation Costs

Although the unit cost of highway construction in the state of Kentucky has been steadily falling as shown by the successive lower prices in recent bids, the highway commissioners of that state believe it still to be much too high and are determined to bring it down still lower.

At a very recent conference of the highway commissioners with the officers of the Kentucky Association of Highway Contractors, the latter demonstrated that common labor has taken its cut and is the largest contributor to reduced highway costs; that the contractor comes next by the elimination of his legitimate profit; and that reductions in the cost of materials have been at best very small and in some cases even negative, and that railroad transportation costs are enormous and entirely disproportion-

ate, generally equalling, in the case of crushed stone, the whole cost of the material F. O. B. cars, and in some cases it equals that cost plus the cost of transportation before the war. Their conclusion therefore is that further reductions, which the public is entitled to in highway costs, must come from material interests and the railroads, that the laborer can only just live on his present wage, and that the contractor can quote no lower prices under present conditions unless he pays the state for the privilege of doing the work.

It is believed that the remedy lies with the state, that any reduction in the present costs will be reflected in lower bids, that the aggregate profits of the contractor would be in direct ratio to the reduction in cost, no increase in the percentage of profits being intended.

This has resulted in the highway commission arranging for conference with the railroad commission, the railroad committee of the senate, and the common carriers committee in the house of representatives, at which it was shown by the highway commissioners that the state is the sufferer from excessive transportation charges and that senate bill 66, intended to facilitate the revision of transportation charges should be warmly supported.

There is little doubt that the conditions described in Kentucky may be reflected more or less in some other states and that strong action of contractors and the general public should be taken to educate individuals and corporations to the necessity of promptly abandoning this unfair and wholly unjustifiable effort to maintain war prices in the face of the reductions already accepted by other interests and the universal public suffering occasioned by the continued profiteering.

In this time of worldwide reconstruction, economy, efficiency and industry should be multiplied, not divided. An obvious measure for the reduction of excessive transportation costs is the extension of motor truck and trailer service and the location, development and operation of local sand pits and quarries. The latter may be and should be efficiently supplemented by the action of the state and federal authorities in making mineral surveys and of the highway departments in locating available deposits, testing them, and advising contractors of their probable availability. At the same time laboratory and field research should be combined with engineering study to provide satisfactory combinations of material and to revise specifications to permit the widest applications of local supplies and the selection of material in accordance with local needs and conditions. Considerable work on these lines has already been done in Pennsylvania and in other states and should be universally emulated.

Water Users vs. Taxpayers

Editor PUBLIC WORKS,
New York City:

In a recent editorial on "Water Users vs. Taxpayers," you ask if it is legal, just or good business to use money paid for water, to construct or maintain other enterprises of the city.

To understand this question, it is better to consider the whole transaction.

To begin, the water department, (or the city for it) issues bonds to furnish capital to construct the works, agreeing to collect sufficient in water rates to pay the interest and maintain the works in good running order. The value of the works is thus the capital, and fixes the value of the bonds; the works being mortgaged to the bondholders. No other enterprise the city may enter into, as streets, parks, etc., is responsible for the payment of these water bonds.

Now, where does the money come from to manage and maintain the works? The water department or city makes a contract with certain individuals, (not with taxpayers), we call them water users, to furnish them a certain definite commodity, at an agreed fixed price per unit. The commodity which the water taker agrees to pay for is WATER and the only thing the city agrees to sell is WATER. There is no agreement on the one part to furnish streets, parks or charity or on the other to pay for them.

If the water user chances to be a taxpayer also he is taxed twice for any city undertaking, outside the water system, which he is compelled to contribute to.

It would seem therefore to pay for any benefit, shared by the whole, by moneys derived from a part of the people, is unjust and therefore illegal and unbusinesslike.

This is well recognized by Public Service commissions, and with that in mind, they demand that the accounts be kept so as to separate the service to the public from the service to the individual.

This subject is worthy of the attention of engineers because of its close relation to efficient management.

Walter H. Richards
Retired Engineer, Water and Sewer Dept., New London, Conn.

Blasting Drilled Wells*

Methods of blasting water wells and conditions under which blasting is desirable.

Within recent years explosives have come into use for increasing the flow of drilled water wells. The method of blasting drilled water wells are much the same as those employed in the oil fields, but the desirability of blasting such a well should first be determined by careful study of its location, its drilling record, and the water supply it is designed to draw upon. Whether it is safe to blast depends largely upon the proximity to buildings and the depth of the well. If the well is in a city close to or within large buildings, it may be dangerous to blast, lest the shattering of the rock underground weaken the foundations of the buildings, or flying fragments of rock do damage above ground. If the well is shallow, any risk there may be of injury to surrounding property is increased. However, wells within a few feet of houses have been blasted without the slightest damage and it is probably safe to say that if the size of

*Excerpted from Du Pont Magazine, Nov.-Dec., 1921.

the charge is proportioned to the depth of the well and the work is carefully done, blasting can be carried out in most places with little risk.

DESIRABILITY OF BLASTING

Whether it will be profitable to blast a drilled water well depends upon the quantity of water in the earth or rock surrounding the borehole, and the character of the formation.

The greater part of the rainfall seeps downward into deeper layers of soil or rock, often completely saturating them. The water in this saturated zone is called the ground water and is the great source of supply for lakes, spring and wells. It is in constant movement from higher to lower levels, flowing evenly through layers of sand or gravel confined by relatively impervious strata, or in rock strata, trickling through the pores of the rock and along joint cracks, bedding planes, solution channels and other crevices. It is, of course, to this ground water that wells are drilled. The United States Geological Survey has made studies of underground water supply in most sections of the country and can furnish maps and other information concerning the depth, abundance and composition of underground waters and the character of both the water-bearing strata and the strata between them and the surface which will be found of great value alike in selecting the well location and drilling the hole and in blasting to increase the flow of water.

Firing a blast at the bottom of a well in sand or gravel would have practically no effect on the flow of the well; the sand or gravel would simply settle back after the explosion into its original place in the porous mass.

If sunk into water-bearing rock, however, a well may draw only from the particular pores or crevices which it intersects and their tributary pores and fissures, and thus secure only a relatively small portion of the water carried by the whole stratum at that point. If passages could be opened into the borehole from the whole area of the surrounding rock, the flow of the well would be immediately increased. Here, therefore, is the function of explosives, for a heavy charge fired at the bottom of the well would increase the sectional area of the hole, making a collecting cavity for water, and would open up radiating fissures throughout a considerable area of the enclosing rock.

BLASTING METHODS

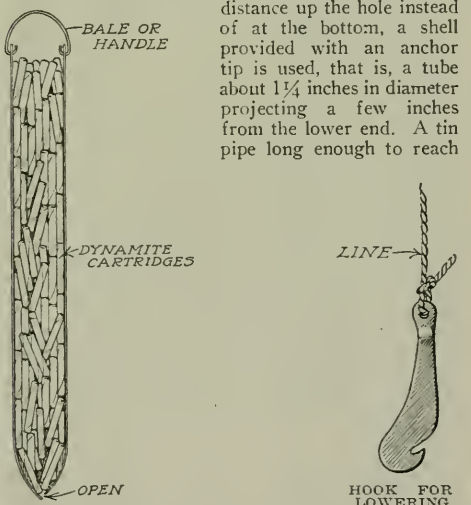
The methods of blasting drilled water wells are derived directly from oil-well shooting. The explosive is usually placed at the bottom of the hole. It sometimes happens that a hole is drilled through a water-bearing area into a lower dry area and in such a case the shot should be fired, not at the bottom of the well, but at the level of the water-bearing rock.

It is advisable to use a quick, powerful explosive and a heavy charge. The best explosive for the purpose is probably Du Pont Solidified Nitroglycerin, but, if this is not obtainable locally, Du Pont 60 per cent Straight Dynamite will also do satisfactory work, provided the column of water which may be standing in the well is not over 200 feet high. The exact size of the charge is governed by the depth of the well, the nature of the rock to be blasted, and the proximity to buildings. For a well 100 feet deep, an efficient and safe charge would be from 100 to 200 pounds of Solidified Nitroglycerin or from 150 to 300 pounds of 60 per cent Straight Dynamite. For every additional 100 feet this loading could be increased by about 100 pounds.

LOADING HOLE

The cartridges are carefully packed in a cylindrical shell ranging usually from 3 to 5 feet in length, made of tin or galvanized iron drawn out to a point at the lower end to prevent it from catching in its descent down the hole, open at the upper end and provided with a wire handle or bail. Such a container can be easily made from an ordinary stovepipe. It should always be at least an inch smaller in diameter than the borehole. If there is standing water in the hole, as is usually the case, and the hole is of considerable depth, there should be an opening in the lower end of the shell, so that the water may pass through the shell and equalize the pressure on the explosive.

When the shell is loaded, the bail is placed over a special hook on the end of a stout line and the shell is slowly lowered down the hole. By a few motions of the line the hook can then be freed and drawn up. In shooting a very deep well, several shells may be necessary to hold the required charge. If so, they can be lowered successively and one allowed to rest on another. In case a charge is to be located at some distance up the hole instead of at the bottom, a shell provided with an anchor tip is used, that is, a tube about 1¼ inches in diameter projecting a few inches from the lower end. A tin pipe long enough to reach to the bottom of the well is securely fitted over this tip and lowered into the hole ahead of the shell to serve as an anchor for it.

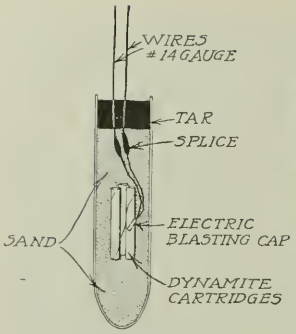


CARTRIDGE SHELL 3 TO 5 FEET LONG

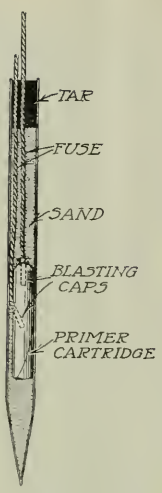
HOOK FOR LOWERING CHARGE OF EXPLOSIVE

FIRING SQUIBS

The charge being seated, the next step is to explode it. This can be done by either the jack-squib or the electric squib. The jack-squib consists of galvanized pipe pointed at the lower end, which is filled as follows: Sand is poured into the pipe to a depth of about 6 inches; a cartridge of 60 per cent Straight



ELECTRIC SQUIB ABOUT 20 INCHES LONG



2-INCH JACK SQUIB ABOUT 3 FEET LONG

Dynamite, primed with two No. 8 blasting caps and two fuses, is seated on the sand, and more sand is poured in until it fills the space around the cartridge and covers it to within four inches of the top of the pipe. This remaining space is then filled with thick tar. As soon as the squib is prepared, both fuses are lighted, two being used in case one should fail, and the squib is dropped into the hole, point down. The length of the fuse should be so calculated that the squib will explode about the time it strikes the charge and thus detonate it.

The electric-squib of the oil-well shooter, which should not be confused with the Du Pont Electric Squib, is similar in construction to the jack-squib, but shorter and larger in diameter with a less sharply pointed end. It is filled to a depth of about 6 inches with sand and then a primer charge consisting of from one to three cartridges of 60 per cent Straight Dynamite is placed in the sand, one of the cartridges having been previously primed with a No. 8 Submarine Electric Blasting Cap. To the wires of this cap, at a point that will come well within the squib shell, are spliced No. 14-gauge copper wires long enough to reach to the bottom of the hole, and the splices are well taped. The remaining space is filled with sand topped with a layer of tar. The squib is carefully lowered by the wires until it rests upon the charge and is then fired by means of an electric blasting machine.

If the well has struck water there will probably be some standing water in the hole. Every foot of water in the hole exerts a pressure of .434 pounds per square inch. Consequently a column of water 100 feet high over a charge of explosives exerts a pressure of 43.4 pounds on every square inch of the area of the charge. It is this pressure which makes it necessary to protect the detonator from moisture by placing it in a sand-filled and tar-sealed metal shell. As the pressure may tend to force out the nitroglycerin from the cartridges, it is important to fire the shot as quickly as possible after loading. All preliminary preparations such as removing objects within danger and notifying people should be completed before the explosive is lowered into the hole so that no time need be lost thereafter.

EFFECT OF EXPLOSION ON CASING.

Most drilled wells contain a casing throughout a part or the whole of their depth. Exploding a heavy charge at the bottom of the well is likely to damage this casing, either blowing it out in fragments, which may do harm if allowed to fly in the air, or causing it to collapse within the borehole, or splitting it longitudinally along the seam.

To prevent the casing from flying into the air it is well to build a heavy grill work over the mouth of the hole. This should be securely anchored to the ground. It is hardly possible to prevent splitting the casing but this is not necessarily a serious result, for a casing that is merely split can easily be pulled out and replaced.

If the casing collapses, however, it is more difficult to remove. In a well 300 or 400 feet deep there is less likelihood that the casing will be blown out or split than in a shallower well, but there is danger of collapse of whatever depth of the well. To prevent the casing from collapsing, the hole should be either full of water to the top or empty of water for fifty feet below the bottom of the casing. This last would mean that the hole was cased through only a part of its length and that the explosive charge was seated at least fifty feet below the casing. Suppose, for example, a well 100 feet deep containing 50 feet of casing from the surface down and 75 feet of water. The explosion of the charge would probably cause the casing to collapse at the surface of water. If the top of the water column was a few inches or a few feet below the casing, the collapse would probably occur at the bottom of the casing. If, however, the water was 50 feet below it, there would probably be no collapse at all. So it is advisable before firing either to fill the hole full of water or to bale it out at a point 50 feet below the bottom of the casing.

Well blasting is neither difficult or dangerous, and it has been found very successful in numerous instances in increasing the flow of water. Under ordinary conditions careful following of the methods described should produce satisfactory results. If peculiar conditions exist, is is well to secure advice from an experienced blaster or an explosives manufacturer.

Evils of Surety Bonding Systems

According to the sentiments expressed in its bulletin, by a number of prominent members of the Associated General Contractors, various faults of the prevailing system of surety bonding include the habit of distributing blank bid bonds haphazard to anybody, whether or not they have any investment, equipment or any experience and the pernicious idea that a responsible bidder is simply a contractor who can furnish sufficient bonds.

Some bonding companies have stated that bonding rates could be reduced if contractors would furnish affidavits of their financial abilities, experience and equipment; requirements that seem so rational that they should always be willingly agreed to by all parties. It has also been suggested that the substitution of certified cheques for bid bonds is likely to obtain more reliable contractors, although it was argued in opposition that a certified cheque is quite as easily obtained as a surety bond.

Table No. 3—Methods of Paving for Paving—Continued

Name of City	Percentage of Paving Cost: Assessed on abutting property.	Percentage of Paving Cost: Paid by city.	Method of Calculating Assessments.	Payable in how many instal-ments.	Funds obtained by city by	Life of bonds, years.
Massachusetts:						
Arlington	all	.....	.....	3	tax levy	3
Athol	.....	all	.....	..	bonds	20
Brockton	.....	all	.....	..	both	5-15
Cambridge	.....	all	.....	..	bonds	10-5
Dartmouth	.....	all	.....	..	budget	..
Easthampton	.....	.....	.....	..	budget	..
Holyoke	.....	all	.....	..	bonds	20
Lawrence	.....	all	.....	..	both	10
Lynn	.....	.....	.....	..	both	..
Pittsfield	50%	50%	By front ft., excl. intersections.	5	bonds	10
Quincy	50%	50%	By front foot.			
Springfield	.....	all	.....	10	bonds	10
Webster	.....	all	.....	..	budget	..
Michigan:				..	.....	..
Alma	all	.....	Front ft., excl. intersections.	5	budget	5
Ann Arbor	80%	20%	Benefits derived.	10	bonds	10
Battle Creek	⅔	⅓	Front ft., excl. intersections.	5	bonds	30
Detroit	all	.....	Front ft., excl. intersections.	4	budget	..
Dowagiac	all	.....	Front ft., excl. intersections.	5	budget	..
Grand Rapids	all	.....	Front ft., excl. intersections.	5-10	bonds	5-10
Hastings	60%	40%	Front foot.	10	bonds	10
Highland Park	all	.....	75% where mostly lots by front ft., excl. intersections.	5	budget	2-6
Holland	all	.....	By front ft., excl. intersections.	10	bonds	10
Ironwood	.....	all	.....	..	both	20
Manistique	.....	all	.....	..	budget	..
Midland	67%	33%	Frontage except in special cases.	10	bonds	10
Niles	all	.....	Front ft., excl. intersections.	10	budget	..
Owosso	60%	.....	50% repaving—foot frontage.	5	budget	..
Sault Ste. Marie	⅔	⅓	Front foot.	1-5	bonds	5-10
Ypsilanti	60%	25%	15% ward—front foot.	10	bonds	1-20
Minnesota:						
Albert Lea	all	.....	Front ft., excl. intersections.	10	both	3-15
Chisholm	.....	all	.....		levy and gen. fund	..
Cloquet	all	.....	Front ft., excl. intersections.	3	.....	..
Crookston	all	.....	Front ft., excl. intersections.	up to 20	budget	..
Detroit	.....	.....	.....	20	bonds	20
Duluth	all	.....	Front ft., excl. intersections—area considered.	5	both	5
Faribault	all	.....	Front ft., excl. intersections.	10	revolving funds and warrants	10
Hibbing	.....	all	.....	..	budget	..
Little Falls	75%	25%	Front foot.	20	both	..
New Ulm	all	.....	Front ft., excl. intersections.	4	both	10-20
Red Wing	all	.....	Front ft., excl. intersections.	15	both	..
Rochester	all	.....	Frontage.	10	bonds	10
St. Paul	.....	.....	.....	10	budget and tax	20
Two Harbors	.....	.....	50% sts. and all but intersections on aves. by ft. frontage.	none	budget	..
Willmer	all	.....	Front ft., incl. intersections.	10	.....	11
Winona	all	.....	By front ft. excl., intersections.	10	budget	..
Mississippi:						
Canton	⅔	⅓	Front foot.	2	both	20
Clarksdale	⅔	⅓	Front ft., excl. intersections.	4	bonds	20
Greenwood	⅔	⅓	Front foot.	5	bonds	20
Hattiesburg	all	.....	Front ft., excl. intersections.	10	bonds	10
Natchez	⅓	⅔	Front ft., intersections by city.	..	.....	..
Missouri:						
Carthage	⅔	⅓	Front ft., incl. intersections.	1-5	bonds	20
Caruthersville	all	.....	Front feet.	5	.....	..
Jefferson City	all	.....	Front ft., incl. intersections.	5	.....	..
Joplin	all	.....	Front ft., incl. intersections.	5	budget	..
Kansas City	all	.....	Front ft., incl. intersections	4	.....	..
Poplar Bluff	all	.....	By front ft., tax bill.	5	.....	5
Sedalia	all	.....	By front ft., incl. intersections.	5	.....	..
Springfield	all	.....	Front foot.	5	.....	..
St. Charles	all	.....	Front ft., incl. intersections.			
St. Louis	all	.....	⅓ on frontage, ⅔ on area.	3-10	bond	20
Webster Grove	all	.....	Front foot.	5	budget	..
Nebraska:						
Columbus	all	.....	Ft. frontage, intersections by city (See Note)	10	budget	..
Fremont	all	.....	By area, excl. intersections.	10	bonds	5-10
Lexington	all	.....	Intersections by city. Assessments extended back to center of block.	20	bonds	20
Lincoln	all	.....	Front foot.	10	.....	..
Nebraska City	all	.....	Ft. frontage and depth of property, excl. intersections.	10	bonds	10-5
Omaha	all	.....	By area, excl. intersections.	10	bonds	20
Nevada:						
Reno	all	.....	Front ft., excl. intersections.	10	both	10
Winnemucca	.....	all	.....	2-3	budget	..
New Hampshire:						
Laconia	.....	all	.....	..	budget	..
New Jersey:						
Bayonne	.....	.....	By front ft., excl. intersections.	3	bonds	10
Bloomfield	50%	50%	By front foot.	10	bonds	10
East Orange	all	.....	50% for repaving. By front ft., excl. intersections.	10	bonds	..
Englewood	.....	.....	By front foot.	2	budget	10
Fort Lee	.....	.....	By zones.	10	bonds	..
Freehold	.....	.....	By front foot.	5	bonds	20
Garfield	⅔	⅓	By front ft. (See Note).	10	bonds	..
Irvington	all	.....	By front ft., acc. to benefits, intersections by city.	10	notes	..
Long Branch	⅓	⅔	By front foot.	..	bonds	20

Methods of Paying for Paving—Continued

Name of City	Percentage of Paving Cost: Assessed on abutting property.	Percentage of Paving Cost: Paid by city.	Method of Calculating Assessments.	Payable in how many instal-ments.	Funds obtained by city by	Life of bonds. years.
New Jersey—Continued						
Millville	50%	50%	Front ft., excl. intersections.	5	bonds and notes	..
Montclair	.....	.....	Acc. to benefits.	10	bonds	5-10
Newark	.....	.....	By area, intersections by city.	5	bonds and budget	30
Newton	.....	all	.....	..	both	1
Nutley	80%	20%	Front ft., excl. intersections.	10	bonds	10
Phillipsburg	.....	all	.....	..	both	..
Salem	.....	all	.....	..	budget	..
Summit	.....	all	Benefits. By front foot.	1	both	life of impv.
New York:						
Albany	all	.....	Repaving by city. Front foot.	5-10	bonds	10
Binghamton	50%	50%	Front ft., excl. St. intersections.	3	both	5
Buffalo	all	.....	Repaving ⅔ prop., ⅓ city. Front foot.	5	budget	..
Corning	⅔	⅓	Front ft., excl. intersections.	4	budget	..
Dansville	50%	50%	Front foot.	20	bonds	20
Fairport	⅔	⅓	Front foot.	10	bonds	10
Fulton	⅔	.....	Front ft., excl. intersections.	10	bonds	10
Geneva	⅔	⅓	Front foot.	10	bonds	20
Glens Falls	½	½	Front foot.	1	budget	..
Gloversville	75%	25%	Front ft., excl. intersections.	5	both	5
Gouverneur	.....	all	.....	..	budget	..
Haverstraw	.....	all	.....	..	bonds	30
Herkimer	⅓	.....	⅔ curb—front ft., incl. intersections.	5	budget	....
Hornell	⅔	⅓	Foot frontage.	5	bonds	..
Hudson	.....	all	.....	..	bonds	not to exceed life of impv.
Hudson Falls	⅔	.....	By area.	1	both	25 most
Lackawanna	50%	50%	Curb—all to prop.—ft. frontage.	20	bonds	20
Little Falls	50%	50%	.....	5	bonds	..
Lockport	⅔	⅓	Front foot.	10	budget	..
Middletown	½	½	Front foot.	5	bonds	25
New Rochelle	.....	.....	By front foot.	..	.....	..
New York City:						
Brooklyn Boro.	Determined by Bd. of Est.		Front foot.	1 or 10	bonds	5 to 50
Bronx Boro	All of new.	All repairing.	Front foot of property benefitted.	10	bonds	..
Manhattan Boro	All of new.	All repaving.	Front foot.	10	bonds and budget	10
Queens Boro	Nearly all.	.....	Front foot.	10	bonds	..
Richmond Boro	All of new.	All repaving.	Area of lot; intersections half block each way.	10	bonds	10
Niagara	all	.....	By front ft., excl. intersections.	10	both	..
No. Tonawanda	all	.....	By front foot.	10	bonds	10
Olean	all	.....	By front ft., excl. intersections.	10	bonds	10
Oneida	⅔	⅓	By front ft., excl. intersections.	10	bonds	10
Oneonta	⅔	⅓	By front ft. or sq. yardage.	10	bonds	short term
Plattsburgh	.....	all	.....	..	bonds	20
Port Chester	50%	50%	Front foot.	1-3	bonds	10
Port Jervis	¼	¾	Front ft., excl. intersections.	5	.....	..
Poughkeepsie	⅔	⅓	Front ft., excl. intersections.	10	budget	1-10
Rochester	all	.....	Front foot.	3-10	bonds	..
Schenectady	all	.....	Front foot.	5	resurf. by bonds	10
Victor	.....	all	.....	..	bonds	20
Watertown	.....	.....	Front ft., excl. intersections.	5	both	..
North Carolina:						
Asheville	⅔	.....	Front foot.	3	bonds	..
Concord	¼	.....	.....	10	bonds	10
Greensboro	½	.....	Front ft., excl. intersections.	10	bonds	1-20
Marlon	½	½	Frontage.	3	bonds	30
Mount Airy	.....	.....	Front foot.	1	budget	..
Wilson	⅔	⅓	Front ft., excl. intersections.	10	bonds	20
North Dakota:						
Dickinson	all	.....	In prop. to benefits.	10	.....	..
Fargo	all	.....	Benefits derived.	15	.....	..
Mandan	all	.....	Area. (See note.)	..	warrants	20
Ohio:						
Akron	all	.....	Front ft., excl. intersections.	10	bonds or notes	10-5
Alliance	all	.....	City 2% of intersections. Front foot.	20	bonds	10-20
Ashtabula	98%	2%	Front ft., excl. intersections.	10	bonds	10
Barnesville	.....	1-50	Front ft., excl. intersections.	10-15	bonds	5-10
Bellaire	98%	2%	Repair 50%-50%. Front ft., excl. intersections.	10	bonds	10
Bucyrus	95%-98%	.....	Front foot.	10	bonds	10
Cleveland	98%	2%	Front ft., excl. intersections.	10	bonds	20-10
Cuyahoga Falls	98%	2%	Foot frontage.	10	bonds	10
Delaware	98%	2%	Front ft., excl. intersections.	10	bonds	10
East Palestine	98%	2%	Front ft., excl. intersections.	10	bonds	10
Fostoria	98%	2%	Front foot.	10	bonds	10
Fremont	98%	2%	Repaving 50%-50%. Front ft., excl. intersections.	10	bonds	10
Greenville	98%	2%	Benefits. intersections by city.	10	bonds	10
Hillsboro	98%	2%	Front ft., excl. intersections.	10	bonds	10
Jackson	98%	2%	Front ft., excl. intersections.	10	bonds	1-10
Lakewood	98%	2%	Front foot by benefits, excl. intersections.	10	bonds	10
Lancaster	90%	10%	50-50 repav. Front ft., excl. intersections.	10	bonds	8
Lawton	100%	.....	Front foot.	2	bond	10
Lima	98%	2%	Benefits. By front ft., excl. intersections.	10	bonds	10-20
London	98%	2%	Front foot.	19	bonds	10
Lorain	85%	15%	Front ft., excl. intersections.	10	bonds	10
Marysville	98%	2%	Front ft., excl. intersections.	5-20	bonds	5-20
Middletown	98%	.....	Front foot and benefits.	10	bonds	10-15
Mt. Vernon	98%	2%	Benefits, front ft. and percent of tax values. Intersections by city.	10	bonds	10

To be continued.

Recent Legal Decisions

CONSTRUCTION OF GARBAGE REMOVAL CONTRACT—SEPARATION OF EXCLUDED MATTER

A party contracting with another to perform a work has the right to proceed free from the hindrance of the other party, and if the latter prevents the doing of the work to such an extent as to render the performance difficult, and largely diminish the profit, or increase the cost, the contractor may lawfully abandon the performance. In an action by a city to recover damages for the non-performance of a contract for the removal of garbage, it appeared that the defendant was by the terms of the contract entitled to have all garbage offered free from oyster shells, and other rubbish which the contract expressly excluded. The New Jersey Court of Errors and Appeals holds, Atlantic City v. Farmers' Supply & Products Co., 115 Atl. 388, that, although the contract did not expressly require the city to offer the garbage in the condition contracted for, the law will imply a covenant that the city will perform a correlative duty, if it is the manifest intention of the parties, and cannot by its own act prevent the contractor from performing the contract according to its terms. It being obvious from the terms of the contract that it was the intention of the parties that the city should co-operate to the extent of offering the character of garbage contracted to be collected, and the contract not requiring the contractor to go to the expense of separating the garbage, if the city did not do its duty, but by its conduct did, wilfully or carelessly, create a condition which imposed an additional burden on the contractor, the latter had a right to complain to the city in order that it might remedy this illegal condition.

MEASURE OF DAMAGES FROM NEGLIGENT OPERATION OF SEWERAGE SYSTEM

The Texas Court of Civil Appeals holds, City of Honey Grove v. Mills, 235 S. W. 267, that damages to a plaintiff by the negligent operation of a septic tank are personal to the plaintiff, and he could therefore recover only for injuries to himself and his wife, and not for the special damages suffered by his two adult daughters. It also holds that if the city, as here, has constructed a sewer and connected it with a branch, at times overtaxing its capacity, or allowing insoluble matters to accumulate in it and obstruct the flow of the waters of the branch, causing it to flow back on private property, its liability for the resulting damage does not differ from that of an individual who so wrongfully or negligently manages his property as to injure another person. The nuisance only became so by the manner of the negligent or wrongful use of the branch as the outfall for the sewer. The jury made the finding of fact that the alleged nuisance was, under the evidence, abatable by the exercise of ordinary care in the operation. In this situation, it was held error to permit evidence as to the depreciated value of the land, the proper measure of damages being the depreciation in the rental value, or use, or special damages to the land.

CITY HELD NOT LIABLE FOR FALL OF DEFECTIVE LIGHT POLE, DEFECT NOT BEING APPARENT ON INSPECTION

A team of mules, becoming frightened, dashed from the roadbed onto a grassy plot, striking a defective electric light pole maintained by the city, with such force that it broke off near the ground, and also near the top, and fell into the wagon, breaking the vehicle and causing the team to run away, inflicting personal injuries on the driver, for which he sued the city. The Kentucky Court of Appeals holds, Cundiff v. City of Owensboro, 235 S. W. 15, that the city was not liable, first, because the frightening of the team, and not the defective condition of the pole, was the approximate cause of the injury; second, the evidence showed that the pole appeared sound and the city had no knowledge whatever of its defective condition. A municipal corporation is not an insurer of the safety of its public ways, but is held only to the exercise of ordinary care to keep such ways reasonably safe, and if a street becomes latently defective, without manifesting such dangerous condition, and its dangerous condition is not known to the city, and could not have been known to the city by the exercise of reasonable care, the city is not liable for an injury resulting from such defect to a traveler rightfully upon the street. Although the city inspector examined the pole at regular intervals before it fell, he could not see and did not know of its internal defective condition.

Until the city was charged with knowledge of the defective condition of the pole, it was not required to take it down or replace it.

ORDINANCES REGULATING MOVEMENTS OF STREET CARS TO ALLOW PASSAGE OF FIRE APPARATUS HELD VALID

The Indiana Appellate Court holds, Union Traction Co. v. City of Muncie, 133 N. E. 160, that ordinances relating to the speed of street cars within the corporate limits of the city and at street crossings, the right of way of its fire department over its streets, and the duty of persons in charge of street cars to stop them and remain stationary upon the approach of any fire apparatus are within the police power and apply to a street railway, although passed after the railway received its franchise. The action was one by the city against a street railway company for damages to the city's fire truck and apparatus through collision at a street intersection, caused by violation of the ordinance.

COMPLIANCE WITH ORDINANCE AS TO FIRE HOSE COUPLINGS

The Delaware Court of Chancery holds, Taylor v. Smith, 115 Atl. 405, that a city department cannot be enjoined from *purchasing* screw couplings for fire hose under an ordinance requiring snap couplings to be *used*, but not forbiding the purchase of screw couplings. If it should be unlawful to use such when purchased, the proper time to ask for injunction would be when the use was undertaken.

NEWS OF THE SOCIETIES

CALENDAR

March 14—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago.

March 14—ENGINEERING SOCIETY OF BUFFALO. Engineers' Club. Secretary, N. L. Nussbaumer, 80 West Genesee St., Buffalo.

March 14-16—INTERNATIONAL GARDEN CITIES AND TOWN PLANNING ASSOCIATION. International conference. London, England.

Mar. 14-16—AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual convention. Chicago, Ill.

Mar. 15—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Mar. 18—ROCHESTER ENGINEERING SOCIETY. Quarter-centennial dinner.

March 22-23—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. 15th annual convention. Claypool Hotel, Indianapolis.

March 22-23-24.—IOWA ROAD OFFICIALS. Tenth annual conference State Highway Commission's office, Ames, Ia

Mar. 29-30—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting. Urbana, Ill.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21—TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; Apr. 30, Youngstown, O.

May 15-19—AMERICAN WATER, ASSOCIATION. 42 Annual Convention. Bellevue-Stratford Hotel, Philadelphia. Secretary J. M. Diven, 153 W. 71 St., New York.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

IOWA ROAD OFFICIALS IN CONFERENCE

The tenth annual conference of Iowa Road Officials will be held in Ames at the headquarters of the State Highway Commission, Wednesday, Thursday and Friday, March 22, 23, 24. It is anticipated that approximately 400 county engineers, supervisors, auditors and township clerks and trustees will take part in the meeting, which promises to be the most important so far held.

Matters of administration, policy and technical problems will occupy the entire time of the conference. Supervisors, engineers and auditors who have special problems to work out and which they would like to have taken up for discussion, are asked to send them in as suggestions for the program as soon as possible.

The conference will be closed to all except bonafide county and township officials. Profiting by the experience of the past, manufacturing and publishing companies are again asked to route their agents and salesmen in other territory during the time of the conference. The shortness of the time allowed for the meeting, the number of matters to be taken up and the importance of the things to be considered, make it imperative that the time of those in attendance be absolutely unhampered. Highway engineers from neighboring states, with problems similar to those in Iowa, will be present to speak and take part in the discussions.

BOSTON SOCIETY OF CIVIL ENGINEERS

The February 15th meeting of the Boston Society of Civil Engineers was addressed by Mr. Gerret Fort, vice-president of the Boston and Maine Railroad, on "Problems of Freight Transportation in New England," and Mr. Benjamin Franklin Fitch of the Motor Terminals Co. of New York on "Co-ordination by the Unit Containers System by the Railways, Waterways, Highways, and Traction Lines for a Relief of New England Transportation."

The meeting of February 28th at Tremont Temple, was addressed by John N. Cole, commissioner of public works, Commonwealth of Massachusetts, on "Problems Due to the Growth of the Motor Truck as a Freight Carrier," and by Prof. W. K. Hatt, Director of Advisory Board on Highway Research, on "General Situation in Highway Transport and the Need of Research in That Field."

NEW JERSEY SEWAGE WORKS ASSOCIATION

The annual meeting of the New Jersey Sewage Works Association held at Trenton on February 17th, was devoted to an exchange of experience on the part of sewage works operators and other engineers. Chief among these were Harry Beaumont, who described hypochlorite disinfection of the Imhoff tank sprinkling filter effluent at the Pennypack, Philadelphia, sewage works; and Prof. R. O. Smith, who described the research studies being made jointly by the N. J. State Experiment Station and the State Dept. of Health, which included the biology of sewage treatment and experiments in facilitating sludge dewatering.

S. F. Miller, of the Pacific Flush Tank Co., was elected president. and Myron E. Fuller, New York City, was re-elected secretary-treasurer.

KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS

At the convention in Louisville, February 21 and 22, the reports of the principal committees were on finance, legislation, publicity, ways and means and future activities, which were discussed, and papers presented on:

"Kentucky's Road Situation," by Joe S. Boggs, State Highway Engineer.

"Reduction of Insurance Costs by the Application of Safety Methods," by S. J. Williams, chief engineer, National Safety Council, Chicago.

"A Close-up View of Workmen's Compensation Insurance," by Lewis F. Tuells, vice-president, Liberty Mutual Insurance Company, Boston.

"The New Specifications of the Highway Department," by W. N. Bosler, principal assistant engineer, Department of State Roads and Highways, Frankfort.

"The Relationship Between Contractor and Surety," by Franklin D. Roosevelt, vice-president, Fidelity & Deposit Company of Maryland.

At the banquet Rodman Wiley was toastmaster and the principal speakers were: H. Green Garrett, "A Voice from the Throne"; Gov. Edwin P. Morrow, "Co-operation"; Gen. R. C. Marshall, "A Message from the National Association"; Frank Cassell, "On the Rock Pile"; Mayor Huston Quin, "The Proper Treatment of Highwaymen."

BROOKLYN ENGINEERS' CLUB

At the informal library talk February 16, a lecture on "Picturesque and Progressive Japan" was delivered by Dr. Thomas Edward Potterson, who illustrated it by very interesting lantern slides. The lecture was preceded by a short musical program.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular monthly meeting February 15th, a paper on "How Can the New York Transit Problem Be Solved," was presented by speaker Daniel L. Turner, consulting engineer to the Transit Commission of New York City.

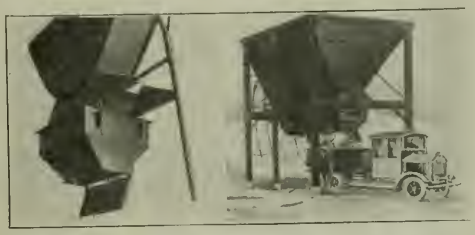
Mr. Turner laid out in a clear and thorough way the underlying principles that should be considered in solving New York's transit problem, covering financial and traffic considerations.

During the business meeting consideration was given to a request of the Board of Direction of the Parent Society that the sentiment of the Local Sections on the question of the Society becoming a member of the Federated American Engineering Societies be indicated to the directors.

It was found necessary to cancel the discussion on "Removal of Solid Wastes" originally scheduled for this meeting.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



BLAW-KNOX MEASURING BATCHER GATE IN OPENED POSITION. STEEL BIN FITTED WITH BLAW-KNOX MEASURING BATCHERS.

ALL STEEL STORAGE BIN AND ADJUSTABLE MEASURING BATCHER

A steel storage bin and adjustable measuring batcher just put on the market by the Blaw-Knox Co. weighs less than an equivalent wooden bin, costs less for shipment, is more quickly and easily dismantled, is more durable, and being of standard size units is a sectional equipment that possesses great elasticity and can be enlarged or reduced to fit any size job. It is of convenient height to be loaded by a locomotive crane and clamshell bucket and has clearance for loading any truck body on the market.

The bins themselves are of the suspended hopper bottom type, designed for maximum strength and economy in units of 15 tons capacity, each equipped with two patent adjustable measuring batchers that automatically deliver exact required amounts of aggregate, are adjustable to any specified proportions, operate by gravity and are controlled from the surface of the ground by levers that can be handled separately or in combinations by the truck driver, thus enabling him to fill several compartments in the truck body simultaneously or successively and complete his load in 10 seconds if necessary. These gates may also be applied to any wooden bin or other steel bin already in service.

The measuring batchers have conical upper parts moving inside the lower parts and adjustable to vary the amount of aggregate delivered by a fraction of a cubic foot at will. The lock bolts furnished with the batcher enable the contractor or engineer to seal the adjusting mechanism so that it cannot be changed without his knowledge and consent, thus eliminating the necessity for any inspector or superintendent at the storage bin, and insuring perfect regularity of proportion in the mix.

The batcher includes the bin gate or bottom of storage bin, and when the gate is closed the material in the batcher is struck off at the same time automatically, and the correct volume is then held suspended in the batcher until the bottom gate is opened to dump it.

GASOLINE LOCOMOTIVE FOR TUNNELS, QUARRIES, ETC.

The locomotives manufactured by the Brookville Truck & Tractor Co. are recommended for Ford efficiency applied to gasoline haulage, particularly in tunnels, quarries, road construction and other operations where a light industrial hauling system is desired.

They are of the underslung type, with cast iron frame, swiveled, pony front, operating over 20-foot radius curves and are made 24 to 56-inch gage. A lighter type with a riveted channel bar frame weighs from 2,850 pounds to 3,250 pounds and, like the heavy type, has Hyatt roller bearings and pony wheels (if especially ordered). Both types are equipped with the new Ford Ton Truck motors, transmissions and worm-drive differentials.

The Ford high and low speeds go forward and reverse, giving a range of from 4 to 15 miles, which together with the swivel front eliminates the necessity of turntables or "y's" because the locomotive is efficiently operated in either direction. The total daily cost of operation for driver, gas and oil is estimated at $6.75 with no cost on idle days while the operating daily cost for five mules required to do the same service is $30 and there is a fixed charge of $8 per day for idle days.

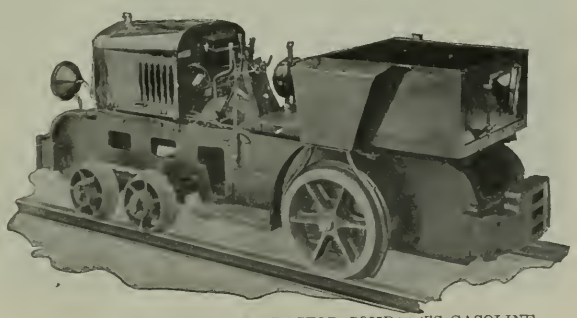
Testimonials from a number of purchasers credit the locomotive with efficiency in various kinds of work. One of them hauled a gross load of 47,500 pounds, another hauled 6 tons up a 10 per cent grade on high gear, another hauled men to and from work, making 14 miles to the gallon of gasoline, another is credited with a saving of $70 per month on labor alone and handles 100 tons in five hours.

THE AGGREMETER

The all-steel AggreMeter, manufactured by the Erie Steel Construction Co., is an equipment designed to insure the rapid loading into multiple compartment motor trucks or into sets of batch boxes, of the exact required proportions of fine and coarse aggregate for delivery to concrete mixers, especially for highway construction. The Agre-Meter consists essentially of two 35-ton hopper bottom steel bins supported on two steel towers placed far enough apart to permit the passage of a motor truck or industrial railway between them.

An overhead service track connects the towers just below the hoppers and on it there are installed two measuring hoppers, each consisting of four compartments and connected by a spacer equal to the distance from the center of the industrial track to the center of the hoppers. The two are traversed from one hopper to the other by a windlass and endless rope, working them both together as a unit.

One measuring hopper, set under the



BROOKVILLE TRUCK & TRACTOR COMPANY'S GASOLINE LOCOMOTIVE.

stone bin, is filled by a single movement of the operator's lever and when traversed by the windlass to the other hopper its contents are struck off by a fixed straight edge that insures the exact quantity of materials in the measuring hopper. When the stone hopper reaches the center of the industrial track, the sand hopper is automatically placed under the discharge gate of the sand bin and is filled while the stone hopper discharges into the truck or batch boxes.

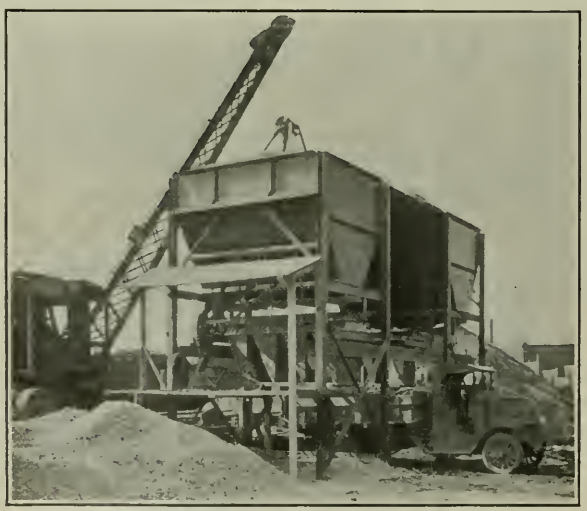
The traversing mechanism, a single-drum hand winch, is then reversed and the stone hopper returned to position under the stone bin, while the sand hopper is placed over the truck or industrial track and its contents discharged, completing the load of the truck or batch boxes, and so on, the hoppers reciprocating and charging and delivering either sand or stone at each movement. The measuring hopper may be made with one, two, three or four compartments and any one of these may be held locked at the will of the operator or opened with each movement. The automatic striking of the contents insures accuracy of measurement and obviates the necessity of inspection after the dimensions of the hopper have been verified.

The plant is operated by only one or two laborers, saves truck time by loading a 4-compartment truck in less than one minute, has capacity sufficient to keep two large mixers going at full speed, and is claimed to cost less than wooden hoppers on account of the durability and facility of dismantling and re-erection. It is claimed to have capacity for loading eighty 6-bag batches per hour, a quantity sufficient to keep two 6 bag paving mixers working at full capacity and allowing only 1½ minutes per batch.

The bin gates are operated by the attendant while the measuring hopper gates, controlled by a large hand wheel and spur gear, are operated by the driver of the motor truck. The gates open slowly, minimizing the impact and consequent injury to the truck body. The measuring hoppers, set to clear the truck bodies, are several feet below the tops of the truck cabs, which do not pass under them, thus reducing materially the height from which the heavy aggregate falls into the truck body.

Whether or not the specifications prohibit storage of aggregate on subgrade, its measurement and delivery from a central proportioning plant is claimed to be more convenient and profitable to the contractor, because of a saving of 10 per cent. loss (enough in 2½ miles of road to pay for the AggreMeter); because there are no interruptions to verify or correct proportions; because, in handling the aggregate, no dirt is mixed with it; and because, when the AggreMeter is used, as the truck is not spotted directly under the bin gate, there can be no overload of aggregate delivered for any batch.

In the construction of more than a mile of 18-foot concrete road in Erie County, Pa., with a 1¼-minute mix specified, the average speed of paving was 440 linear feet in 10 hours. The 680 truck-loads of aggregate were measured and delivered to three 5-ton trucks by an AggreMeter that loaded the 2331 six-bag batches with one operator in an average time of 60-75 seconds per truck-load. The contractor stated that during the same number of days the AggreMeter could have loaded 10,800 batches.



LOADING BATCHES OF AGGREGATE WITH ERIE STEEL CONSTRUCTION COMPANY'S AGGREMETER.

PERSONALS

Laurent, Arthur St., assistant deputy minister of the Canadian Department of Public Works, has been appointed chief engineer to succeed the late E. D. Lafleur.

MacCutcheon, John, has been appointed superintendent of bridges for Bridgeport, Conn.

Fourmy, James M., has been appointed state highway engineer and W. F. Cooper assistant state highway engineer of Louisiana.

Craven, William, bridge engineer of the North Carolina State Highway Commission, has been appointed senior bridge engineer.

Cocke, W. F., assistant state highway engineer of Virginia, has resigned to become state highway engineer of Florida.

Maline, J. F., has been appointed director of public service of Cleveland, Ohio.

Syme, George F., supervising engineer, North Carolina State Highway Commission, has been appointed senior highway engineer.

Campbell, Homer C., has been appointed city manager of Akron, Ohio.

Wiles, H O., formerly city engineer of Bluefield, W. Va., has been appointed county engineer of Wayne county, W. Va., to succeed H. A. Levering.

Allen, George K., Red Bank, N. J., has been appointed county engineer of Monmouth county, N. J., succeeding George B. Cooper.

Bunker, Stephen S., has been appointed city engineer of Bangor, Maine.

Newman, Gustavus O., chief engineer for the San Joaquin Light and Power Company, died in Los Angeles Cal., on December 4th.

Archibald, Alexander, mayor of Newark, N. J., died on February 11th, following an operation.

WILLIAM C. SARGENT

William C. Sargent for twenty-two years secretary and also a director of the Chain Belt Company, Milwaukee, died suddenly on February 5th as a result of heart failure. He was seventy-three years of age and had been in ill health for several years.

Mr. Sargent, prominent in industrial circles of Milwaukee, and St. Paul, had a wide national acquaintanceship. He was born at Troy, New York, February 2nd, 1849. In 1871 he moved West, locating at St. Paul. In 1900 he went to Milwaukee to become secretary and later a director of the Chain Belt Company. He was also a director of the Federal Malleable Company, West Allis, Wisconsin. His father was one of the founders of the Terre Haute, Alton and St. Louis Railroad. Mr. Sargent established many of the early business connections of the Chain Belt Company, many of which are still among the company's jobbers.

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

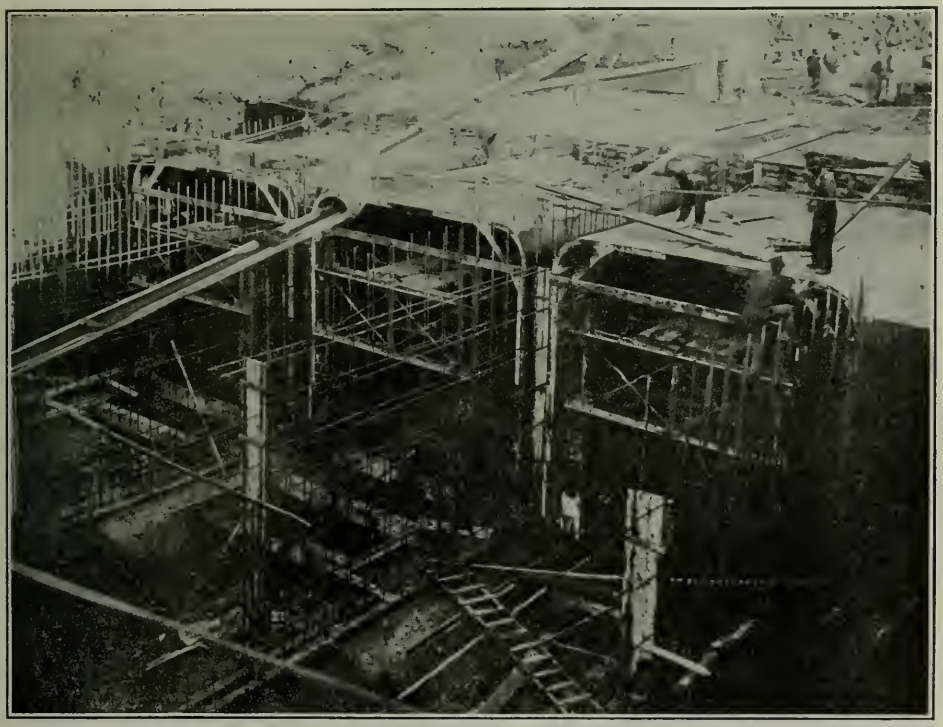
Vol. 52 March 11, 1922 No. 10

Constructing Conner's Creek Sewer

Mechanical equipment installed for building 7,770 feet of 22½ x 55-foot triple conduit in open trench, using dragline excavator, steam shovel, industrial track and trains, locomotives, concrete mixer plant, and collapsible steel forms, with 375 men.

An important element of the $35,000,000 sewer system now under construction in Detroit is the Conner's Creek Sewer, about 7 miles long, for which 7,770 feet of 22½ x 55-foot sewer in sections 1 and 2 is now being built by the Gillespie Contracting Co., New York, for a contract price of $2,190,850. The contractor, with a force of about 375 men, is now making a progress of about 40 feet daily.

This sewer, which is claimed to be the largest ever built, has an outside rectangular cross section 55 feet, 1 inch in width and 22 feet, 6 inches in height, containing three parallel rectangular barrels 15 feet,



THREE COLLAPSIBLE STEEL FORMS, SET READY FOR CONCRETING.

9 inches inside width and 17 feet, 6 inches inside height, with flat roof, vertical walls, rounded upper corners, and invert concaved on the upper surface to a radius of 16 feet, 6 inches. The thickness of the invert at the center and of the flat roof slab is 22 inches, that of the exterior walls is 23 inches and of the partition walls is 16 inches. The roof and invert are reinforced by transverse bars and, with the vertical walls, are also reinforced by longitudinal ½ and ⅞-inch bars, all of them placed at least 3 inches from the surface of the 1:2:4 concrete. All of the 1,970 pounds of reinforcement per linear foot is made of square bars and the shear bars are bent to 45 degree angles. About 14 yards of concrete per linear foot is required.

EXCAVATION

This section of the sewer is built in an open trench involving 250,000 or more yards of excavation in blue clay, which is made chiefly by steam shovels operating in the trench and followed by a Bucyrus dragline machine operating at the surface of the ground, trimming the subgrade just in front of invert construction, and delivering to dump cars on a service track alongside the cut, which transfer the spoil back to the finished structure and dump it there for backfill.

In some places the sides of the trench are protected with steel sheet piling, but in most cases the material is so firm that it will stand safely unprotected with a vertical face and indeed will also support in addition a heavy-surcharge, as is demonstrated by the operation of the massive dragline machine close to the edge of the deep unprotected cut.*

The trench is obstructed by very little transverse bracing. The tops of the sheet piles used in special cases are anchored by wire ropes to dead-men buried in the ground some distance from the trench, and are braced by light, temporary steel struts having rectangular cross sections and built up with four corner angles latticed together on all sides, and set high enough to clear the top of the roof slab.

CONCRETING

All construction materials are delivered by rail to the contractor's yard adjacent to the sewer, where they are unloaded on side tracks and the aggregate is transferred to elevated bins, with five gates through which five cars of a 10-car train are simultaneously loaded and then hauled forward to receive the proper amount of cement from chutes in the cement shed, while the remaining 5 cars are being loaded with aggregate and then in their turn advanced to receive their cement, permitting the train to be loaded with great rapidity. Thirty cradle cars of the Koppel "Ideal" type are used having a capacity of 40 cubic feet and equipped with spring draft gear and double springs, suspended inside cage roller bearings, with cast steel wheels, and transporting 36-foot batches. The cars are hauled by a Burton gasoline locomotive on a 36-inch gage track. For the maximum 1-mile haul a round trip is made in 30 minutes by the 10-car trains. On shorter hauls 6-car

*See front cover, issue of February 25.

DELIVERING AGGREGATE FROM LOADING BIN TO MEASURING DUMP CARS.

trains are used to serve the mixer with an output of 33 cubic yards per hour.

The material cars are dumped directly into the charging hopper of the steam-driven Lakewood mixer installed on the platform of the traveling hoisting tower that moves alongside the sewer trench on a broad-gage track.

The mixer discharges into a hoisting bucket, which is operated in a wooden tower, braced and guyed to a moving platform, and dumps into a receiving hopper, which serves a revolving steel chute supported by a steel boom, which also carries a counter-weighted truss supporting a second pivoted section of chute. From this second pivoted section the concrete is spouted to receiving hoppers for the terminal chutes, which are suspended by trolleys on overhead cables, which permit the chutes to be quickly shifted to deposit concrete in any part of the trench.

The invert is concreted separately in short sections in advance of the walls and roof, and vertical rods project from its surface to bond with the vertical rods in the side and partition walls. Except on curves, the walls and roof slab are concreted with the aid of six

ABOVE—MOVABLE MIXING AND HOISTING PLANT.
AT THE LEFT—SPOUTING CONCRETE FROM TRAVELING HOISTING TOWER.

sections of Blaw-Knox collapsible steel forms at each of the two points about ¼-mile apart where the work is in progress; one set of three forms being collapsed, scraped, pulled and readjusted while the other set is in service, and the concreting gang is transferred to the opposite section, returning to the first section again and concreting it while a set of forms is being shifted on the other section, and so on, thus affording continuous employment for both the concreting and the form gang.

The steel forms are supported on adjustable inside structural steel towers running on broad gage invert tracks. The forms are shifted after the concrete is five days old. While in service the outside forms are braced against the sides of the excavation. Consecutive sections of the sewer are separated by construction joints made with vertical and horizontal tongue and groove connections and bonded together by horizontal longitudinal bars projecting about 2 feet from one section into the next section.

The alignment is tangent, except for one section of 100-foot radius, one short reversed curve, and two 90-de-

gree curves. In building these curves the steel forms used elsewhere were replaced by ordinary wooden forms having horizontal, longitudinal lagging strips in walls and roof nailed to transverse pieces supported on and braced to interior posts, caps, and struts, all of which are knocked down and removed after the concrete has set sufficiently. At the 90-degree curves the outer faces of the sewer were concreted against the steel sheeting driven there to retain the sides of the trench.

On the tangents a progress of about 20 feet a day is averaged at each of the two points where work is in progress.

Protecting Concrete Bridge Girders from Locomotive Blasts

The Clarendon Street bridge in the city of Boston is a short, wide structure, carrying the street obliquely over the lines of seven tracks of the Boston and Albany and New York, New Haven & Hartford railroads. The bridge has a granite block pavement laid on a reinforced concrete floor slab supported on Bethlehem H-beams and riveted girders, completely encased in a protecting mass of concrete. The concrete enclosing the bottom figures of the girders is continuous from girder to girder, thus enclosing the spaces between the girders and providing a flat ceiled surface underneath them, and only a short distance above the tops of the stacks of the locomotives that pass beneath the bridge.

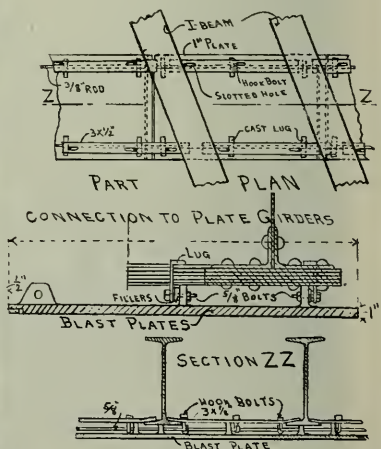
In order to prevent the injury of the concrete by the high-pressure locomotive blasts containing sulphur and other injurious elements, the surface of the concrete is protected by cast iron plates, 30 inches by 49 inches and 1-inch thick, provided on adjacent edges with ship lap joints 2½ inches wide with 1½ inch normal overlap, thus making a continuous flush surface and allowing for expansions or irregularities in construction.

The cast iron plates are provided on the upper side with pairs of lugs 3 inches high, cored for ⅝-inch bolts that in some places engage lugs attached directly to the lower flanges of the plate girders. In other cases the holes receive long ⅝-inch continuous rods that can be supported at irregular intermediate points by hook bolts passing through slotted holes in 3 x ½-inch transverse bars supported at their ends on the bottom flanges of the steel beams and girders.

The lugs, rods and bars are all enclosed in the solid mass of concrete that protects the bottom flanges of the girders and is extended to enclose the beam and girder webs, while the cast iron plates form a continuous smooth, durable surface protecting the concrete.

The granite block pavement is laid on a cement and sand cushion under which there is a heavy waterproof coating protecting the upper surface of the concrete floor slab. There is a longitudinal mastic joint one inch thick between the edges of the concrete pavement and the curb, which rises 6 inches vertically above the top of the pavement and is protected by ⅛ x ¾ inch bar anchored to the curb concrete by ¾-inch staggered bolts 8 inches apart.

BRACING AND ANCHORAGE FOR STEEL SHEET PILES.



METHOD OF SUPPORTING CAST IRON BLAST PLATES FROM GIRDERS WITH CONNECTIONS EMBEDDED IN CONCRETE.

Garbage Collection in St. Paul

By James W. Routh, M.Am. Soc. C. E. *

Discussion of methods, cost and quality of the service in that city. Garbage is collected partly by city and partly by farmers and fed to hogs, with little direct supervision. City collection costs about seven dollars a ton.

The possibility of developing anything to approach uniform and standard practice in the methods of collecting garbage and other household wastes may perhaps be questioned. It is believed, however, that such a possibility does exist, in spite of the fact that this important service is rendered by municipalities with varying degrees of success, at costs ranging widely and by methods which in most cases show little indication of economical development.

If there is any virtue in the interchange of ideas and experiences, then such interchange should by all means be encouraged with regard to refuse collection and disposal. It is certain that by no other process can decision be reached as to the development of principles and practices which may have general application. So long as each municipality stumbles along in its own way with its problem, and so long as the occasional investigations made by engineers in some of the larger cities continue to be made each one without reference to principles which may apply to all, just so long will extravagant and careless methods be the rule. Variations in local conditions are cited too frequently as excusing irregular practices which result in economic losses in addition to costs out of proportion to the character of the service rendered.

With these thoughts in mind, it is proposed to discuss herein the methods, cost and quality of the service in question as performed in the city of Saint Paul. It is believed, as stated, that the problem in any city is one which is capable of scientific analysis; that there are certain more or less fixed principles in connection with it that may profitably be observed by any municipality confronted with its solution.

The discussion of Saint Paul's practice, present and proposed, therefore, is intended to accomplish two purposes:

First, to give information concerning one city's procedure;

Second, to indicate possible principles which may have general application.

GENERAL DATA

The city of Saint Paul, according to the latest census, has a population of about 234,000. It is located in a hilly country and occupies a total land area of approximately 52 square miles. There are about 840 miles of streets, of which 107 miles have hard surfaced pavements and 43 miles are paved with macadam. The remainder are dirt roads, about half of which are wholly unimproved. In addition there are 283 miles of alleys, of which about 6 miles are paved. (These figures do not include pavements laid in 1921.) The average snowfall, according to the reports of the weather bureau, is 40.1 inches; the annual rainfall is a little more than 27 inches, while the mean temperatures are 25 degrees in winter and 61 degrees in summer. The soil for the most part is sandy, although there is some clay.

Garbage is disposed of in Saint Paul by feeding it to hogs, and by the individual householders burning and burying it. The city does not own or operate a piggery; garbage is fed by a large number of farmers in the vicinity. Some of these men come into the city under license and collect garbage from selected routes, hauling it to their farms outside the city limits. There also are three large piggeries, owned and operated privately, which buy from the city garbage that is delivered to them by collectors employed and paid by the city.

The farmers operating under license, of whom there are 56, pay an annual fee of $5 for this privilege. Thirty of these farmer collectors have assigned routes in the residential sections of the city and are required to make two collections each week from them. The remaining 26 farmer collectors take garbage only from hotels, restaurants, clubs, etc. It is estimated that approximately 10,000 tons of garbage are collected privately by licensed collectors in the course of a year. No accurate records, however, are available.

The sections of the city not served by the farmer collectors are covered by collectors employed directly by the city. These men work under the supervision of the superintendent of the Bureau of Sanitation in the Department of Public Works. There are, on the average, 32 city collectors who, as a matter of course, collect garbage in those sections of the city where the least desirable conditions obtain; where the houses are widely separated, and where the poorest quality of garbage is found. They also collect, and deliver to the three piggeries contracting for its disposal, about 10,000 tons of garbage per year. It is estimated that, in addition, there are about 3,000 or 4,000 tons of garbage produced each year which are not handled by either city or farmer collectors.

PRESENT METHODS AND COSTS

The city of Saint Paul has been fortunate thus far in being able to have at least half of its garbage collected and disposed of without cost. The 56 farmer collectors, as stated, are estimated to collect 10,000 tons of garbage each year. Actually their routes include about half of the city, according to population, and of course they obtain the richest garbage. The annual license fee collected from these men produces a small revenue and at the end of the present year it will be doubled. This step

*Consulting Engineer, Saint Paul Bureau of Municipal Research.

will be taken in order to give the city authorities a little better control over the men than they now possess.

The garbage which is collected from the 32 city routes, as distinct from the farmer routes, is sold to three piggeries at prices (effective September 1, 1921) of $0.90, $1.57 and $1.02 per ton, respectively. The revenue from this source amounts to about $12,000 per year and is applied to reduce the cost of the collection service. The latter cost is somewhat high, totaling about $71,000 during the year.

Until November 1, 1921, the city collectors were paid $185 per month. For this sum they provide a driver who collects, a team and the running gear of a wagon. The wagon boxes are furnished by the city, and are wooden boxes having a capacity of about three cubic yards. They can be emptied only by shoveling and, of course, are more or less unsanitary, even though well cared for and frequently washed.

On the first of November the collectors accepted a wage reduction of $25 per month, making the wage rate from that date $160 per month. This reduction will mean a reduction of nearly $10,000 in the total annual cost of the service.

For the first seven months of 1921, the records show total deliveries to the three piggeries amounting to 4,346 tons. The cost of collection during that period amounted to $4,217.14, giving a unit cost of collection of $9.68 per ton. During July, a month of high collections, there were 954,151 tons collected, at a unit cost of $6.84 per ton. There are available no accurate records of collections for any period prior to January 1, 1921, hence the unit cost for the year can only be approximated at about $7.10 per ton; in all probability it will not be less than this, and it may be more, depending upon how rapidly the quantities collected fall off during the last three months of the year. The figure given is net for collection, and does not allow for any reduction on account of revenue from the sale of garbage.

In spite of the fact that this unit cost is somewhat high, the net unit cost for the entire city is quite low. Since half of the total garbage is collected without cost, and a revenue of $12,000 is received from the sale of part of it, the total net cost becomes about $60,000 for approximately 20,000 tons collected, or $3.00 per ton.

Quality of Service

The quality of service for garbage collection is not easy to determine, especially under the conditions which obtain in Saint Paul. It is common practice to accept the number of complaints of non-collection, irregular collection, etc., as being a measure of the quality of service and of the degree of satisfaction of those served. This is believed, however, not to be a fair criterion. The number of complaints can be no true index of the quality of service. There are too many variable factors in the question. Few complaints may mean either unusually good service, or service so bad that householders have become convinced of the futility of repeated complaints. The most satisfactory use of complaints occurs when close supervision is provided over collectors, when the latter are subject to frequent checking up by independent inspectors and when the complaints received are systematically followed up, satisfied and tabulated as a part of the record of the several collectors.

The tabulation of complaints may give the supervising officer, under the conditions laid down, an index of the effectiveness of his inspection service, of the relative reliability of his collectors and of the sections of the city where most educatioinal work is required. The latter is important from many standpoints. The following up of complaints many times discloses conditions pertaining to the house treatment of garbage that prevent or hinder effective service from the collectors. These conditions generally arise through the ignorance of the householders or their failure to appreciate the need for co-operation with the collectors in obtaining regular and satisfactory collection service. Valuable educational work can frequently be done by tactful inspectors in such cases. This, in turn, not only satisfies many complaints but keeps the general public informed of the character of service performed for them and of which they seldom think except to curse for its faults.

In Saint Paul there is little direct supervision over the collectors, and almost no checking up of their work by inspectors. This is especially true of the farmer-collectors, and as a result it is difficult to determine with any degree of accuracy how satisfactory is the service provided. Complaints are received in irregular quantities; most of them, from the records kept, are against the city and not the farmer collectors. On the other hand, it becomes necessary at intervals to discontinue farmer and substitute city collectors on various routes, because of unsatisfactory service from the former. It has been noted also that the farmers are inclined to reduce their collections to a minimum during the period of heaviest garbage, when they may be occupied in harvesting their crops. Some of the farmer collectors, furthermore, have been inclined to give up their routes with the falling prices of pork and corn. These factors, in particular the need for ensuring greater reliability, have all entered into the decision to increase the annual license fee charged the farmer collectors from $5 to $10. This, it is believed by the city officials, will tend to eliminate those farmers who are least inclined to collect garbage for hog feed. It is obvious, however, that collection by farmers without cost to the city cannot be depended upon in the future. Before many years have passed all collections undoubtedly will have to be made by collectors employed by the city.

The work of the city collectors, directly under the control of the Bureau of Sanitation, is especially difficult to appraise. The routes served by these men represent the most difficult collection conditions in the city, since most of them have been abandoned by the farmer collectors, who find it profitable to collect only where the ease of collection is relatively high and the quality of garbage the best. Consequently the city collectors serve territory where houses are widely separated, where few of the streets are paved, and where the class of residents is least likely to co-operate in making the collection service good. Hence the fact that complaints of poor service are more frequently lodged against city than against farmer collectors should not be given too much weight. Nevertheless the number of such complaints indicates the need for closer control through inspectors and field supervisors. It is im-

possible properly to control any such work solely from the office, as is now practically the case.

Complaints are received at the office of the Bureau of Sanitation, where they are entered in a daily log. The collectors, as many as have access to telephones, are required to call the office daily and are then notified of complaints from their routes. They are expected to make the collections required in answer to complaints the day following, but frequently fail to do so since there is no further follow-up by the officers of the Bureau. A Ford truck, used in other work mornings, makes special collections on complaint during the afternoons. As a considerable number of the regular collectors either do not have access to telephones, or cannot understand instructions given in that manner, it is evident that chief reliance must be placed on the truck for answering complaints. It is also evident that control over collectors and the handling of complaints in general is not altogether satisfactory. Better results would be obtained if all collectors were reached daily with complaints of non-collections on their routes and were required to answer and satisfy the complaints on the day received. This could be accomplished by providing field supervisors who would be in touch with the office at frequent intervals during the day.

(To be continued)

Notice to Bidders of Possible Change of Highway Location

The following circular letter to contractors has recently been issued by the State Highway Engineer of Missouri:

Re Project No. 105—Sec. A—Iron County

A change in location near Tip Top between stations 200 and 330 is contemplated and if the change is made it will be done during construction.

The contemplated change will probably increase the quantities, and it is requested that you carefully examine this possible relocation before submitting your bid on March 3rd.

Mr. George Mattingly, project engineer assigned to this work, is located at Ironton, Missouri, and has his offices over Adolph's jewelry store. He is equipped with two Ford cars and by applying to him at Ironton he will arrange to show you the contemplated change in location.

We are asking that each contractor submitting a bid for this work sign a statement attached to the bidder's blank, stating that he has carefully examined this contemplated change in location and that his unit prices take into consideration said contemplated change. A bidding blank with this form attached will be provided upon application to Division Engineer H. D. Griffith, DeSoto, Missouri, for plans and specifications.

You will be further advised that any bid in which the unit price for rock excavation exceeds the unit prices shown on the engineer's estimate of cost for same will be considered as an unbalanced bid, and will be rejected.

Jefferson City, Mo., Feb. 15.

Alexander V. Graham,
State Highway Engineer.

In explanation of this announcement the following letter has been addressed to the editor:

Without entering into a discussion of the merits of the policy of arbitrarily limiting bids on certain items of work, a policy which this department has never regularly put into effect, the local conditions in the particular case in hand justify an arbitrary limit of bids on rock excavation, on account of the fact that the engineer's estimate, which has already been published and cannot well be changed at this time, contained only a nominal amount of rock excavation, whereas, the Tip Top relocation, if adopted, will greatly increase the quantity of rock excavation to be done by the contractor, and the tendency of bidders to place high unit prices on this item might reasonably be anticipated, since the bid is based on the quantities in the engineer's estimate, which contains a relatively small amount of rock.

The circular letter referred to was put out by the department in order to avoid the possibility of being required to reject an unbalanced bid, a procedure which it is always best to avoid, if possible, especially in public work, where criticism of the action of public officials in the matter of letting contracts is always forthcoming upon the slightest excuse.

Very truly yours,
MISSOURI STATE HIGHWAY DEPARTMENT,
Kirk McFarland.

Jefferson City, Mo., Feb. 25.

This notice is discussed editorially in this issue.

Bid Prices for Missouri Road Work

The State Highway Department of Missouri last month awarded to the lowest of twenty-three bidders a contract for building a graded earth road 6.36 miles long and 24 feet wide, and for three bridges between Huntsville and Keytesville. The engineer's estimate, the prices of the low bidder and the highest bid for each item were as follows:

Item	Estimated Quantity	Unit Prices: Engineer's estimate	Unit Prices: Lowest bidder	Unit Prices: Highest bid
Earth excavation	33,781 cu. yds.	$ .50	$ 0.26	$ .448
Borrow	20,244 cu. yds.	0.50	.24	.44
Class B, Conc. Mas. (1:2:4)	333.3 cu. yds.	30.00	18.50	27.00
Class C, Concr. Mas. (1:3:5)	6.0 cu. yds.	28.00	25.00	28.00
Reinforcement	23,681 lbs.	.08	.035	.07
15 in. Cor. Culvert	56 ft.	2.00	2.00	2.20
24 in. Cor. Culvert	40 ft.	3.00	3.00	3.30
Rip-rap	25 sq. yds.	2.50	2.00	2.75
Bridges				
Class B Concrete.	203 cu. yds.	30.00	20.00	27.30
Reinforcing steel	20,550 lbs.	.08	.035	.07
Temporary trestle	50 ft.	10.00	10.00	10.00
Timber piles	560 ft.	1.25	.60	1.25
Concrete piles	180 ft.	3.00	3.00	4.00
Class A, concrete (1:2:3)	57 cu. yds.	30.00	22.00	55.00
Class B, concrete.	106.5 cu. yds.	33.00	18.00	33.00
Class C, concrete.	50.5 cu. yds.	35.00	24.00	40.00
Reinforcing steel.	15,100 lbs.	.08	.035	.07
Structural steel	36,900 lbs.	.085	.054	.095
Gas pipe	313 lin. ft.	.65	.30	.65
Creosoted piles	800 ft.	1.75	1.20	1.75
Class A concrete.	1.8 cu yds.	75.00	50.00	75.00
Class B concrete.	111.9 cu. yds.	30.00	20.00	30.00
Reinforcing steel.	5,360 lbs.	.08	.035	.07

The engineer's estimate was made in May, 1921, and his total estimate at that date was $65,750, while the lowest bid was $37,734, and the highest was $55,471. This difference undoubtedly is a result of the fall in prices of materials and labor, apparently indicating that this has been about 40 per cent.

Single-Track Roads in Illinois *

Vermilion County, Illinois, in 1916 designed and has since then completed 210 miles of single-track paved roads, of which 170 miles was constructed by the county itself, 30 miles by townships forming connecting links, and 10 miles by the State. This system reaches into every section of the county, connecting every town with the county seat, and with

*Excerpts from paper by P. G. McArdle, former superintending engineer of Vermilion county, Illinois, before Good Goods Congress.

each other. A considerable accomplishment for a county with a population of 80,000, and an assessed valuation of $62,000,000.00. Outside of one north and south road (Dixie Highway) and one east and west road, the balance of the system serves every need, and will for many years to come.

All of the single track roads built by the county had gravel or macadam shoulders constructed on each side of the ten foot slab. Of these roads 140 miles were ten foot concrete, and thirty miles were ten foot monolithic brick roads. The State constructed originally ten miles brick road on concrete base, of which somewhat over a mile was double track, of the remainder three miles had macadam shoulders, and five miles without shoulders. This latter was widened to eighteen feet. All of these roads have given satisfactory service.

Rapid Laying of Monolithic Brick Pavement

Section A of the Lincoln Highway in Ashland county, Ohio, is 1.9 miles long and has a 15-foot brick surface on a 5½-inch concrete foundation, involving 10,000 yards of earth excavation hauled a maximum distance of about 600 feet. The alignment is practically level on the old location. The contract price was $81,000.

The excavation was made with an 18-B Bucyrus steam shovel. The aggregate for the 17,800 square yards of concrete foundation was received in railroad cars, handled by Galion unloaders, and mixed in two 7-B Koehring pavers requiring for their operation a force of about 50 men. The concrete was spouted to position on sub-grade by a pivoted chute, was roughly spread by hand to a thickness slightly above the required depth, and was quickly and economically leveled by a template riding on the forms and chained to the paver that hauled it forward as it advanced. The mixture was comparatively dry and was spread by two men working in advance of the template-scraper.

The paving bricks were stored in piles alongside the road and were delivered to the pavers by a gravity roller conveyor about 18 feet long that was set transverse to the axis of the road and rolled longitudinally on it.

Enough helpers were provided to keep the conveyor continuously supplied with bricks, which it delivered to all parts of the roadway, where the pavers worked at high speed to keep up with the concrete machine, a result they could never quite accomplish. The best bricklaying record was 376 linear feet in one 8-hour day. Work was commenced August 15 and completed October 15, with a total force of about 80 men, who finished the job about 8 months ahead of the required time.

F. J. Mann & Son, Wauwatosa, Wisconsin, was the contractor for the work, which was executed under the supervision of Gus Otter, county surveyor, and L. C. Harrick, state highway commissioner. H. C. Mann, of the contractor's firm writes that "the only data we have on the Koehring machines is the time lost with them, which was less than 30 minutes for two pavers for all the season's work, and the repairs were less than $10 on both machines."

Proposed Hudson River Highway Suspension Bridge

There is now before the New York State Legislature a bill to charter the construction of a highway toll bridge across the Hudson river between Bear Mountain and Anthony's Nose at a point 40 miles above New York City, which would afford the only bridge service across the river below Poughkeepsie, 73 miles above New York. As the bridge would afford direct communication between the popular Palisades Interstate Park and the beautiful drive on the east bank of the river it would doubtless have a large tourist traffic which it is conceded would yield sufficient revenue to make the enterprise an attractive one and yield a handsome profit before the bridge, according to the terms of the charter, reverts to state ownership at the expiration of 30 years or is purchased by the state at any one of previous fixed dates for specified varying sums.

The design contemplates a wire cable suspended structure with a 1,650-foot main span having at least a 22-foot roadway and two 4-foot sidewalks and supported at a clear elevation of 135 feet above the water level by two steel towers at the water's edge with rock foundations.

The proposition includes the construction of nearly 3 miles of approach road connecting with the Albany Post Road and with the State Highway at opposite ends of the bridge and involves fixed tolls of from fifteen cents for pedestrians to $1.75 for automobile trucks. The project is advanced by the Terry & Tench Co., New York, and their associates who are prepared to build and operate the structure.

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Bricklayers Served by Gravity Conveyor

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Heavy Sewer Construction

The construction of the $35,000,000 combined sewerage system in Detroit to serve an area of more than 80 square miles and an estimated population of 2,500,000 is now well advanced and includes some notably large and heavy work of which the three-barrel 55x22-foot conduit is the largest or among the largest ever built. About a mile and a half of this great structure is being built by the open cut method in a trench excavated in stiff blue clay by low-level steam shovels and a heavy high level dragline machine that practically eliminate hand work and continuously deliver large quantities of material to dump cars hauled by steam locomotives.

Concrete materials are loaded by gravity from elevated bins to batch cars hauled by locomotives to the travelling concrete plant that delivers directly to the forms with a high degree of efficiency.

A complete cycle of operations is carried on at each of two separate points and an excess number of collapsible steel forms are provided allowing an alternation of work to permit the concrete to harden that secures continuous operation as the gang shifts back and forth.

The liberal equipment of costly power plant installed, careful planning and co-ordination of operations and the employment of a force of 375 men has secured a profitable efficiency enabling the contractor to earn approximately $11,200 per day on tangent construction.

A Scrupulous Highway Department

A practical desire to exercise even-handed justice between the state and the contractors and to warn the latter in advance against speculative bids, is shown in a recent circular letter addressed by Alexander Graham, State Highway Engineer of Missouri, to bidders on project No. 105-Section A Iron County, wherein he advises them of a contemplated change in location, urges personal inspection of the proposed route, offers transportation and official conduct to bidders visiting the site and encloses a blank, to be attached to the bid, stating that the bidder contemplates change of location in fixing his unit prices.

Such a frank and practical way of insuring the contractors' attention and full appreciation of the character of the work to be executed, is certainly an agreeable act that strongly tends to inspire confidence and satisfaction and should go far to stimulate trust and promote reciprocal frankness and good faith. When a specification is supplemented in this extra-legal manner there should be little need to fear any hidden jokers, unfair clauses, misleading paragraphs, or ambiguity.

Restricting Unit Prices

The notice above referred to, however, although it is obviously intended to be a fair announcement of policy and to draw impartial limits for the bids, does not propose a procedure that appears to be generally commendable, even though in the present case it may be justified. In it bidders are specifically warned that "any bid in which the unit price for rock excavation exceeds the unit price shown on the engineer's estimates of cost for same, will be considered as an unbalanced bid and will be rejected."

Judging from the explanation appended, which was made in reply to our inquiry, the special local conditions and the exigences of the case warrant this unusual restriction of bids, but in a general way that restriction is not in harmony with the broad principles of open public competition, and if often applied would be likely to work to the disadvantage of the public and the contractor, and might discredit the estimate.

The limitation of unit prices must inevitably be a delicate and probably complicated matter that would be strongly opposed, but possibly might be desirable if all unbalancing of bids could thus be prevented. It is, however, probable that as many bids have been essentially unbalanced against the interests of the contractor by reason of arbitrary, unexpected or unavoidable changes in conditions, quantities, classifications and interpretations, which he was powerless to prevent, as have been made in his favor by manipulations of unit prices.

If the price restriction can be made perfectly fair and its principles extended to all the features of the contract it would probably not be subject to as much adverse criticism, but it seems doubtful if this is possible, and even if it were, the method taken to

secure the desired results seriously impairs the flexibility which is an essential of any satisfactory contract other than one based wholly on absolutely predetermined knowledge, accuracy and stability of conditions, quantities and other features.

There are several serious objections to arbitrary limiting of unit prices. The engineer's function is that of design and supervision only. If the engineer's estimate is to be final, the contractor should simply be invited to accept or reject the work on the engineer's price offered.

The risk is entirely the contractor's and he should be allowed to determine his methods and prices accordingly.

It is inevitable that the experienced contractor derives his unit prices from considerations and from data different, in some cases at least, from the best that the engineer can secure.

The contractor is entitled to, and necessarily must, distribute some items of overhead cost and other general expenses throughout the items bid upon, which do not and cannot include them specifically, although their legitimacy is unquestioned. He may very properly wish to locate a considerable number of them so as to provide for early payment for plant installed, material purchased, or risks involved that the engineer may not, and perhaps cannot taken into consideration in his most careful estimate of direct costs.

The contractor may contemplate methods of executing the work that will greatly increase one item of cost and decrease another and should be entitled to bid in accordance, the sum of the items multiplied by the engineer's estimated quantities being a proper guide for determination of the respective costs of the work by different bids.

In most contracts specific clauses provide that changes may be made and the quantities increased or diminished at the pleasure of the engineer. From this the contractor has no recourse, and considerable changes in the amount of certain quantities or classification of others may be of great importance to him and are more likely to work an injury than to benefit him because they unbalance his schedule and provisions. The engineer is also naturally very cautious in making such changes that will greatly increase the cost to the owner of the work over his estimate, while the saving due to economies on work, which may necessarily involve a large outlay for plant installation or a corresponding dimunition of the contractor's legitimately anticipated profits, are not objectionable to his employers.

The danger of serious injustice to the owner through the operation of an unbalanced contract is generally very small if the contract, specifications and plans are properly prepared after sufficient investigations, and are efficiently carried out.

Some sort of sliding scale for prices or allowances, rebates or changes should be made for any considerable variation of quantities and for unclassified or indeterminate work, but it should be remembered that the unit allowances for increments or decrements of the estimated quantities should usually differ materially from the original unit prices. When these allowances are properly made they serve as an automatic check and the contractor who insists on unit prices that are too high for any important items will lose the contract on the merits of his own competitive bid. It, therefore, appears to be both unfair and unnecessary for the engineer to arbitrarily fix unit prices.

Mahomet Goes to the Mountain

With billions of dollars worth of all sorts of construction, especially engineering construction, urgently needed, and with almost unlimited capital and equipment available for it, it is useless to deny that this country is still far behind its proper and necessary degree of activity. The post-war inertia is still potent, and too much of the sorely needed resumption of important enterprises has been of the galvanic nature produced by passing the buck to the government and creating a large volume of public work, especially highway construction. This, while undoubtedly serving as a tonic, does not sufficiently nourish the great national industrial and commercial system until the adjustments of labor and prices are complete enough to reassure capital which must be relied upon to carry out the numberless enterprises and improvements that must soon gather momentum for years of unexampled prosperity.

Meantime it is still such a rocky road to prosperity and so costly waiting, that determined spirits are hastening to meet prosperity rather than wait for its delayed advance. The courage and foresight which will anticipate and create present opportunities will be safely launched to ride on the crest of the coming wave instead of being swamped by it, and the apparent risk of a judicious investment carefully planned and conserved will disappear with its profitable execution.

This is particularly true of various public utilities of the non-imperative type that tend to beneficial developments and to greater convenience, the use of which is optional with the public, but which have a real economic value. It may be impossible to secure the appropriation of public funds for them at the present time and difficult to underwrite them in the open market, but when individuals with ample resourses and experience undertake such a project with full knowledge of the details, it is to be presupposed that the enterprise is sound, and while the public is the beneficiary, no interest or individual is injured or seriously jeopardized and the promoters are due to receive a well deserved reward.

While the $100,000,000 mammoth railroad bridge project to span the Hudson River at New York City is slowly progressing with patient private enterprise, active steps have been taken, as noted on page 180, for the immediate construction of another popular Hudson River bridge to form an important link in the highway system of New York State and greatly benefit thousands of automobilists touring the magnificent Hudson valley.

Although the proposed span is slightly longer than that of the greatest of the three huge suspension bridges between New York and Brooklyn, the comparatively light design necessary for automobile traffic only, reduces the weight and cost of the bridge to a fraction of that for carrying multiple railroad tracks. The experience and high development that have been attained in the art make both design and construction a comparatively simple matter, especial-

ly under the favorable conditions and location selected by the promoters, who are experienced practical bridge builders, successful in many previous large enterprises.

Lincoln Highway

During 1921, 297 miles of the Lincoln Highway have been completed at a cost of $7,737,473, plus a maintenance cost of $1,735,433 in the eleven states of New Jersey, Pennsylvania, Ohio, Indiana, Illinois, Iowa, Nebraska, Wyoming, Utah, Nevada and California. The total length of the highway will be, when completed, 3,305 miles, on which $40,000,000 has been expended during the past 9 years. The classification of types of hard-surface roads includes about 522 miles of concrete, 241 miles of brick, 383 miles of bituminous macadam, 287 miles of stone macadam, 78 miles of asphalt, 6 miles of creosote block and 7 miles of granite block. The largest amount of new construction done on it last year in any one state was nearly 110 miles in Nebraska.

Taxing Gasoline for Road Work

The taxing of gasoline as a means of raising funds for highway work has been adopted by a number of states as the most convenient and practicable method of assessing funds on automobile users in proportion to the amount of use they make of the roads. Wisconsin is proposing to impose a tax of one cent on each gallon of gasoline sold in the state, which, it is estimated, would bring in a revenue of one and one-quarter million dollars. So far as we have kept track of the legislation, about a dozen states are now taxing oil as a means of raising highway funds.

Table No. 3—Methods of Paving for Paving—Continued

Name of City	Percentage of Paving Cost: Assessed on abutting property.	Percentage of Paving Cost: Paid by city.	Method of Calculating Assessments.	Payable in how many instalments.	Funds obtained by city by	Life of bonds, years.
Ohio—Continued						
Nelsonville	98%	2%	Front ft., excl. intersections.	10-20	bonds	10-20
New Boston ...	all	.....	Front ft., excl. intersections.	15	bonds	15
Niles	98%	2%	Front ft., excl. intersections.	10	bonds	10
Oberlin	98%	2%	Front ft., excl. intersections.	10	bonds	10
Salem	98%	2%	Repav. 50-50. Front ft., excl. intersections.	10-20	bonds	10-20
Sandusky	98%	2%	Front ft., excl. intersections.	10	bonds	10
Sidney	all	.....	Front ft., excl. intersections.	10	bonds	10-20
Toledo	98%	2%	Benefits based on frontage, intersections by city.	5	bonds	10-30
Urbana	98%	2%	Front ft., excl. intersections.	10	bonds	10
West Park	98%	2%	Front ft., excl. intersections.	10	bonds	30
Wooster	98%	2%	Front ft., excl. intersections.	10	bonds	10
Zanesville	98%	2%	Front foot.	5	bonds	5
Oklahoma:						
Ada	all	.....	Chgd. to lineal ft. served.	10	.....	..
Hugo	all	.....	By front ft. and ¼ block.	10	budget	..
McAlister	all	.....	Front ft. (See note.)	..	.....	10
Sapulpa	all	.....	Front foot.	10	.....	10
Shawnee	75%	25%	By area.	10	budget	10
Oregon:						
Astoria	all	.....	Benefit basis.	up to 20	.....	..
Baker	100%	.....	Area of lot.	10	bonds	20
Eugene	all	.....	Front ft., excl. intersections.	10	bonds	10
Klamath Falls..	100%	.....	Area of lot.	10	.....	10
La Grande	all	.....	Front ft. and intersection zones.	10	.....	10
Oregon City ...	all	.....	Replacements by city. Front ft.	10	budget	..
Portland	all	.....		20 semi-annual	.....	..
Salem	all	.....	By front ft. and in zones.	10	bonds	10
Pennsylvania:						
Ashley	⅔	⅓	Front foot.	..	both	20
Beaver Falls ..	⅔	⅓	Front ft., incl. intersections.	..	both	30
Berwick	⅔	⅓	Front ft., incl. intersections.	..	bonds	30
Carrick	.....	.....	Front ft. and area of lot.	4	bonds	25
Chester	all	.....	Front ft., excl. intersections.	10	budget	..
Clearfield	all	.....	Alleys ½ city, ⅔ prop.; front ft., excl. intersections.	.. 6 mos.	..... bonds and taxes	.. ..
Connellsville ...	all	.....	Front ft., city intersections.	..	both	5
Du Bois	⅔	⅓	Front foot.	lump sum	both	20
Duquesne	all	.....	Acc. to benefits.	1	.....	..
Farrell	⅔	⅓	Front ft. ,excl. intersections.	..	bonds	15-25
Franklin	all	.....	Benefits and damages, intersections by city.	..	bonds	..
Freeland	⅔	⅓	Front ft., excl. intersections.	3-5	both	10-20
Greensburg	⅔	⅓	Front foot.	..	bonds	..
Greenville	⅔	⅓	Front foot. Sheet asphalt, all by owners but intersections.	..	budget	..
Hazleton	⅔	⅓	Front foot.	..	budget	..
Huntingdon ...	⅔	⅓	Front ft., excl. intersections.	..	bonds	..
Kane	all	.....	Front ft. excl. Intersections.	..	budget	..
Kingston	⅔	⅓	Front foot.	..	both	short term
Lebanon	all	.....	Front ft., excl. intersections.	5	bonds	15
Monongahela ..	⅔	⅓	Front ft., excl. intersections.	..	bonds	..
Munhall	⅔	⅓	Foot frontage.	..	bonds	20
Norristown	.....	.....	Front ft., excl. intersections.	1	bonds	30
North Braddock	⅔	⅓	Front foot.	2	bonds	2
Oil City	all	.....	Front ft., excl. Intersections. Repav.—all by city.	5	both	5-20
Parkersburg ..	all	all	Cement by prop.	..	budget	..
Pittsburg	⅔	.....	Front foot.	2	both	30
Pottstown	.....	⅓	Front ft., excl. intersections.	1	both	30
Pottsville	.....	all	.....	..	bonds	..
Rankin	⅔	⅓	Front foot.	1	bonds	..
Sewickley	⅔	⅓	Front foot.	3	budget	..
Shippensburg ..	none	.....	State and borough.	..	bonds	20
St. Marys.....	⅔	⅓	Front foot.	..	bonds	15
Swoyerville	⅔	⅓	Front foot.	3	bonds	20

Methods of Paying for Paving—Continued

Name of City	Percentage of Paving Cost: Assessed on abutting property.	Percentage of Paving Cost: Paid by city.	Method of Calculating Assessments.	Payable in how many Instal-ments.	Funds obtained by city by	Life of bonds, years.
Pennsylvania—Continued						
Tyrone	⅔	⅓	Front ft., incl. intersections.	..	both	30
Uniontown	⅔	⅓	Front ft.	..	both	30
W. Homestead	.....	all	Curb by prop.	..	.....	..
Wilkes-Barre	.....	.....	Per front foot base.	10	both	5
Wilkinsburg	⅔	⅓	Front foot.	..	both	30
Williamsport	all	.....	Intersections by city.	10	both	10
York	all	.....	Intersections by city.	10	bonds	10
Rhode Island:						
Pawtucket	.....	all	.....	..	notes	..
Westerly	.....	all	.....	..	budget	..
Woonsocket	.....	all	.....	..	.....	..
South Carolina:						
Charleston	all	.....	Front ft., incl. pt. of st. intersection.	10	certificates	10
Chester	50%	50%	By front foot.	10	bonds	30
Columbia	50%	50%	By front ft., excl. intersections.	..	bonds	20
Greenville	½	½	Front foot.	..	bonds	20-40
Spartanburg	50%	50%	Front ft., excl. intersections.	5	bonds	20
South Dakota:						
Mitchell	all	.....	Front ft., excl. intersections. Intersections according to area.	10	.....	..
Tennessee:						
Clarksville	⅔	⅓	Front ft., excl. intersections.	10	bonds	10-20
Cleveland	⅔	⅓	Front foot.	5	bonds	20
Jackson	⅔	⅓	Front ft., Incl. intersections.	10	bonds	10
Johnson City	85%	15%	On valuation of lot.	10	bonds	20-30
Texas:						
Amarillo	⅔	⅓	Front ft., incl. intersections.	5	bonds	30
Beaumont	⅔	⅓	Front ft., excl. intersections.	..	bonds	20-40
Bonham	⅔	⅓	Front ft., excl. intersections.	10	bonds	..
Cameron	⅔	⅓	Front ft., Incl. intersections.	..	bonds	30
Cisco	¾	¼	Front foot.	3	bonds	40
Corpus Christi	¾	¼	Frontage, excl. intersections.	5	bonds	40
Dallas	all	.....	Frontage, excl. intersections.	6	both	40
Denton	⅔	⅓	Frontage, incl. intersections.	3	bonds	40
Eastland	⅔	⅓	Front ft., excl. intersections.	3	bonds	40-20
Fort Worth	all	.....	Front ft., excl. intersections.	3	both	20-40
Mineral Wells	⅔	⅓	Front ft., excl. intersections.	3	bonds	20-40
Texarkana	.....	all	.....	..	bonds	20
Waxahachie	.....	¼	Front foot.	5	bonds	40
Wichita Falls	¾	¼	Front foot.	3	bonds	30
Utah:						
Logan	all	.....	Front ft., excl. intersections.	10	budget	..
Vermont:						
Barre	½	½	Front ft., excl. intersections.	5	budget	..
Rutland	.....	.....	.....	..	bonds	4
Springfield	.....	all	.....	..	budget	..
Virginia:						
Charlottesville	.....	all	.....	..	both	..
Danville	.....	all	.....	..	bond	25
Fredericksburg	.....	all	Sidewalks by prop.	..	budget	..
Newport News	.....	all	.....	..	bonds	10
Norfolk	.....	all	.....	..	bonds	20-15
Petersburg	.....	all	Sidewalks only assessed.	1	both	40
Salem	.....	all	.....	..	bond	..
Suffolk	.....	all	.....	..	bonds	10-20
Washington:						
Bellingham	all	.....	Area of lot. (See Note).	5-10	.....	6-12
Chehalis	all	.....	Area, incl. intersections.	10	none	10
Dayton	all	.....	Area in zones.	10	.....	12
Okanogan	.....	.....	.....	10	both	10
Puyallup	all	.....	Front ft., incl. intersections.	10	.....	12
Raymond	all	.....	Zone method, intersections assessed to district.	..	budget	10
Seattle	all	.....	By area in zones.	10	budget	..
West Virginia:						
Bluefield	75%	25%	Area, excl. intersections.	3	budget	..
Fairmont	.....	½	Front ft., excl. grad. & intersect.	1	budget	..
Parkersburg	all	.....	Front ft., excl. intersections.	10	bonds	10
Wheeling	⅔	⅓	Front foot.	10	bonds	35
Wisconsin:						
Appleton	all	.....	Front ft., excl. intersections.	5	budget	..
Cudahy	all	.....	Front ft., excl. intersections.	5	budget	..
Delavan	all	.....	Benefits to lot, excl. intersections.	10	budget	..
De Pere	all	.....	Front ft., excl. intersections.	10	budget	..
Edgerton	.....	.....	Benefits, all grad. by city, ⅔ intersections.	5	both	..
Fond du Lac	.....	.....	Actual cost up to $3 yd.	5	budget	5
Green Bay	all	.....	Front ft., excl. intersections.	5	budget	..
Kaukauna	.....	.....	Front foot.	1	both	5-10
Lake Geneva	33⅓%	.....	Part by county. Front foot.	10	both	5-10
Madison	.....	.....	Prop. up to $6 per ft. City all above. Ft. front., excl. intersect.	10	bonds	10
Manitowoc	50%	50%	Front ft., excl. intersections.	5	bonds	20
Marshfield	all	.....	Front ft., excl. intersections.	5	budget	..
Milwaukee	.....	.....	Assessed up to $3 per sq. yd. Above that 50% by city.	6	budget	..
New London	⅔	⅓	By sq. ft., excl. intersections.	3	both	10
Oshkosh	.....	.....	.....	5	both	1-5
Sheboygan	all	.....	Front ft., benefits & damages; intersection by city.	5	budget	..
Sparta	⅔	⅓	Front ft., excl. intersections.	5	bonds	1-5
Superior	all	.....	Front foot.	5	general funds	5
Waukesha	.....	.....	Front foot or benefits & damages.	10	.....	10
Wausau	50%	50%	Foot frontage.	..	budget	..
Wisc'sin Rapids	⅔	⅓	Front ft., excl. intersections.	1	bonds	6
Wyoming:						
Casper	all	.....	Area of lots acc. of zoning system	10	both	10
Sheridan	all		Area & zone.	10	bonds	10

Recent Legal Decisions

EFFECT OF RESERVATION OF RIGHT "TO REJECT ANY AND ALL BIDS"

Where both the state statute providing for an award of public works to the "lowest responsible bidder" and the notice published for bids reserved the power to the commissioners' court authorized to let the construction of a highway bridge to "reject any and all bids," the Texas Court of Civil Appeals holds, Holt & Co. v. Wheeler County, 235 S. W. 226, that this was notice to any intending bidder that the commissioners' court was not obligated to accept any bid that might be made or to award any contract thereon unless the court deemed the bid the lowest and the bidder satisfactory and adjudged the acceptance thereof to be for the best interests of the county. The proposal bound neither party, and neither party acquired a right against the other. The advantage to the bidder is no part of the design of the statute, and no such right is created in his favor as forms the subject of an action at law or of a suit in equity.

Under the terms of the statute, it was held that the commissioners' court might, in its discretion, reject the lowest bid and award the contract to another bidder on the ground that this would serve the best interests of the county. And where the state highway engineer appointed by the state highway commission threatened not to give the county financial act if the highway contract was awarded to the lowest bidder, the rejection by the commissioners' court of the lowest bid and the acceptance of a higher bid was held not an abuse of discretion.

DIVISION OF LARGE STREET RAILWAY SYSTEMS INTO SEPARATE ACCOUNTING DISTRICTS WITH DIFFERENT RATES OF FARES

In reducing street railway fares of the Connecticut Company within the limits of the city of Bridgeport from 10 cents to 5 cents for a test period of ninety days, the Connecticut Public Utilities Commission says, November 12, 1921, that, while large centres of population should assist in supporting the tributary lines having to do with the social, business, and industrial activities of the community, they should not be called upon to assist in the maintenance of street railway service in remote sections of the state. The system of a railway covering a large territory should be divided into separate accounting districts, each district to comprise such territory and municipalities as are closely connected with each other and are daily dependent in their social, business, and industrial activities upon intercommunication and transportation, each district to be self supporting and allow the company a fair return on the value of the plant and equipment therein located and used, the rates of fare to be so adjusted as to afford such return, irrespective of what the rates may be in other districts.

TRIALS OF CHARGES AGAINST MUNICIPAL OFFICERS OR EMPLOYEES NOT SUBJECT TO RULES GOVERNING JUDICIAL TRIBUNALS

The California District Court of Appeals, Third District, in Butler v. Scholefield, 201 Pac. 625, holds that trials of charges against an officer or employee of a municipality or county are not controlled by or subject to the rules that appertain to judicial tribunals, where the Legislature has expressly given the governing body of the municipality or the county the exclusive cognizance or jurisdiction of such trials, and the law creating such body the exclusive tribunal by which such trials should be had makes no provision for disqualifying a member from acting upon the ground that he is biased or prejudiced against the officer or employee on trial. This, the court considers is sustained by the greater weight of authority, though there are cases holding that municipal boards in proceedings for removal act judicially, and that therefore those boards whose members prefer the charges are disqualified from sitting as members of the council or board on hearing them, since they cannot act both as accusers and judges.

MUNICIPALITY'S POWER TO PURCHASE ESTABLISHED WATER SUPPLY SYSTEM

Under the provision of the California Municipal Incorporation Act, permiting cities of the sixth class to acquire and construct water supply systems, and notwithstanding the provision therein prohibiting the levying and collection of property tax in excess of $1 on each hundred without the assent of two-thirds of the electors, and the section prohibiting trustees from incurring a liability in excess of the available money in the treasury legally apportioned and appropriated therefor, it is held, Kane v. Wedell, (Cal.) 202 Pac. 340, that a city of the sixth class could purchase and establish a water supply system under the Public Utilities Act of 1913, and levy an assessment on the property of owners within the city to furnish the purchase money.

TAXPAYER HELD NOT ENTITLED TO INTERVENE IN SUIT BY CITY

A taxpayer cannot intervene in an action by a city to enforce rates for light and power lower than the rates a light and power company insists it has the right to charge. The Michigan Supreme Court City of Grand Rapids v. Consumers' Power Co., 185 N. W. 852, holds that the taxpayer's contention that if the suit were continued he with other taxpayers must bear the burden and pay the expenses, and therefore he had a right to be heard in the suit could not be sustained, otherwise taxpayers might intervene in all suits brought by the city because they were paying the bills. In litigation brought by a city the taxpayer is heard through the accredited representative of the city, the city attorney.

NEWS OF THE SOCIETIES

CALENDAR

March 14—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago.

March 14—ENGINEERING SOCIETY OF BUFFALO. Engineers' Club. Secretary, N. L. Nussbaumer, 80 West Genesee St., Buffalo.

March 14-16—INTERNATIONAL GARDEN CITIES AND TOWN PLANNING ASSOCIATION. International conference. London, England.

March 14-16—AMERICAN RAILWAY ENGINEERING ASSOCIATION. Annual convention. Chicago, Ill.

March 15—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Mar. 15—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINERS. Joint meeting with A. I. E. E., A. S. C. E. and A. I. M. E. Engineering Societies Bldg., New York City.

March 18—ROCHESTER ENGINEERING SOCIETY. Quarter-centennial dinner.

Mar. 20—CONNECTICUT STATE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Taft Hotel, New Haven.

Mar. 21—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hydro-electric symposium.

March 22-23—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. 15th annual convention. Claypool Hotel, Indianapolis.

March 22-23-24—IOWA ROAD OFFICIALS. Tenth annual conference State Highway Commission's office, Ames, Ia.

March 29-30—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting, Urbana, Ill.

Apr. 3-5—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drake Hotel, Chicago.

April 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

April 19-21—TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

April 27-30—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 29, Massillon, O.; April 30, Youngstown, O.

May 15-19—AMERICAN WATER ASSOCIATION. 42d Annual Convention, Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71 St., New York.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

JUNE 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

NEW ENGLAND WATER WORKS ASSOCIATION

The March meeting of this association will be held at the Boston City Club March 14.

Programme — Morning — Meeting of Executive Committee at the headquarters, Tremont Temple. Luncheon served at the Boston City Club.

Afternoon—"The Corrosion of the 36-in. Steel Main at Akron, Ohio," by G. Gale Dixon. (Illustrated.) "Investigation of Electrolysis of Steel Force Main at Akron, Ohio," by Victor B. Phillips. (Illustrated.)

These two papers will furnish valuable information in reference to the corrosion of steel mains by stray currents. Mr. Dixon will describe general conditions at Akron, and summarize corrosion results in other steel mains; Mr. Phillips will give in detail an account of the electrolytic survey and the solution of the problem at Akron.

Time permitting, discussion will be had on one of the following practical subjects:

"Carrying Cast Iron Pipes Through Foundation Walls."

"Use of Extension Stems Over All Street Gates."

"Operation of Distribution System with Valves Partially Closed."

ENGINEERING SOCIETY OF BUFFALO

The March 14 meeting of the Engineering Society of Buffalo will be addressed by Col. E. Lester Jones, director of the U. S. Coast and Geodetic Survey and Commissioner of the International Boundary, United States-Canada, on "Surveying from the Air."

IOWA HIGHWAY OFFICIALS CONFERENCE

The conference of the Iowa Highway Officials scheduled for a three-day session at Ames, March 22, 23, 24, will be in the nature of a short course in highway construction, maintenance and administration in which not less than 450 officials are expected to participate.

There are approximately 650 supervisors, engineers and auditors, all of whom are actively concerned in directing road work from an administration or engineering standpoint. There are approximately 6,500 township trustees and clerks who are in charge of the township road work. The invitation is extended to all officials, state, county and township, to come prepared to take part in the conference. The work of the conference will be organized much like a college short course.

There will be sessions devoted to road maintenance, to grading, drainage, graveling, hard surfacing, secondary road improvement projects and the like. Those engineers or officials whose work has been most successful along each particular line or who have had most experience in handling that particular type of work, will be placed on the program to open these especial topics. Others with similar experience will be scheduled to follow with discussion of the topic as presented, or with ideas from their own experience. The discussion will then be thrown open for full participation by all in attendance.

Every discussion is carried on with the idea of bringing out the best means and methods of getting the work in hand done quickly, economically and satisfactorily. Problems in administration, contracting, uniform cost accounting and methods of keeping road building records will be conducted in the same manner.

While most of the meetings are joint sessions, separate meetings will be scheduled for the auditors, supervisors and engineers, at which they will take up the especial problems which confront them and which are not of especial interest to the other officials. Each division will arrange its own program for discussion and conduct its own meeting.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A meeting of the Baltimore section of the American Society of Mechanical Engineers was held at the Engineers' Club on March 8. This included a morning trip around the harbor, an afternoon session on "Material Handling and Harbor Development," and in the evening a banquet with addresses on subjects of general interest, at which W. W. Pagon presided.

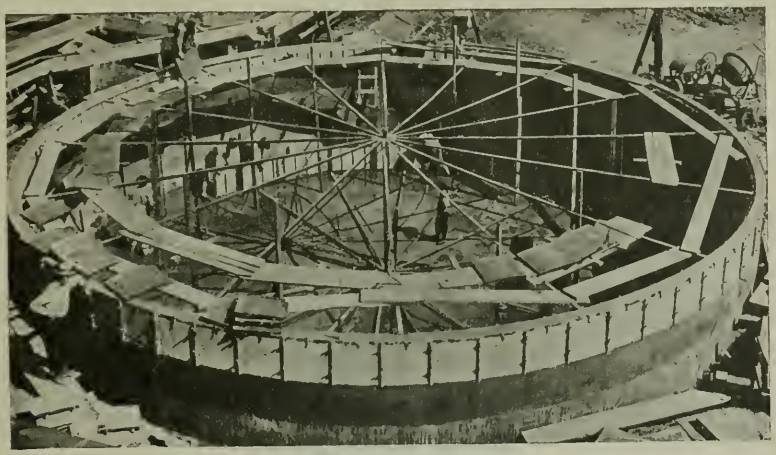
The Colorado section held a meeting on March 10 at the Metropole Hotel, Denver, which was addressed by C. H. McClintock of the Denver Tramway Co., on "The Power Situation of the Denver Tramway."

The Connecticut State section has two meetings scheduled: one on March 11 to discuss the affiliation of the technical societies of Connecticut, and one on March 20 on "The Human Element in Industry." The speakers at the meeting are J. J. Callahan, president of the Employees' Representation Service, New York City; J. E. Bennett and President Dexter S. Kimball. Both of these meetings will be held at New Haven.

The Philadelphia section will hold a hydro-electric symposium on March 21 at the joint meeting of the Engineers' Club of Philadelphia, sections of the A. I. E. E., A. S. C. E. and A. S. M. E. with the co-operation of the Hydro-Electric Power Commission of Ontario, Sir Adam Beck, chairman. Discussion will be held on the actual operation of the Chippewa Queenston Development of the Hydro-Electric Power Commission of Ontario with special reference to the 55,000 H.P. water wheels put in operation in January.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



CONCRETING LARGE TANK WITH METAFORM CORPORATION'S INTERCHANGEABLE FLANGED, CLAMPED AND DOWELED STANDARD UNITS

FLAT AND CURVED FLANGED STEEL FORMS

Metaforms manufactured by the Metal Forms Corporation, consist of interlocking, interchangeable steel units, flange connected together to build up forms for many different kinds of concrete construction. The standard rectangular unit for flat surfaces is a 24 x 24-inch panel of 16-gage steel with 1 x 1-inch flange angles on all four sides and a cross angle to stiffen it in the center. Dowel pins are set in the sides to align it and clamps provided to hold the flanges in place are locked or unlocked by a single push.

Metaforms for circular construction are also made with 16-gage sheet steel and 1 x 1-inch flange angles and are strengthened on the center by a 1-inch flat bar parallel to the axis of the cylinder to which the sheets may be sprung. Each unit is aligned by means of two dowels, and is furnished with two clamps, riveted on that engage rivet heads in the adjacent units. They are handled by a center erection mast with fittings to keep it in alignment, and the mast is provided with a radial arm and two tip buckets, which are alternately hoisted by the derrick and revolved to position horizontally and emptied into the form. Adjustable forms are provided for conical roof construction.

A combination of cylindrical and conical forms with standard units and very few of them are listed for making manholes of various diameters.

METAFORM CORPORATION'S STANDARD ADJUSTABLE UNIT FORMS FOR MANHOLES

AIRDRY ELECTRIC TOWEL

The Airdry Corporation, manufacturer, has issued a leaflet describing automatic electric appliance for installation in lavatories, public buildings, comfort stations and other places for the elimination of cloth and paper towels in drying the hands. It is made in several patterns of enameled iron, mounted on

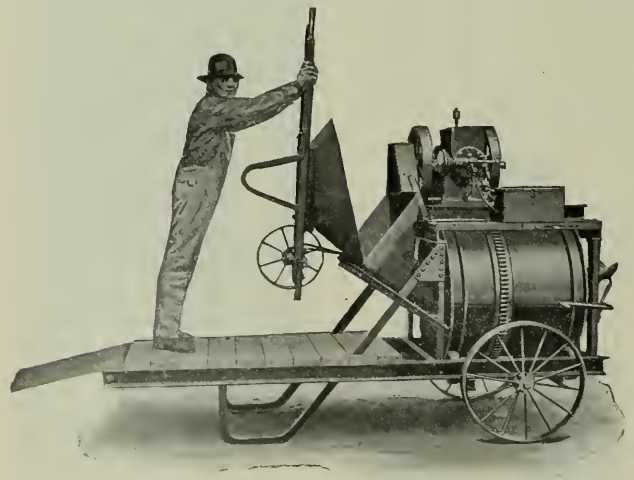
AIRDRY CORPORATION'S ELECTRIC TOWEL APPARATUS FOR LAVATORIES

the wall or on pedestals and is easily installed by providing a circuit of not smaller than No. 14 B and S. A. G. A. wire, with the nearest junction box. It consists of a standardized universal motor, fan and heating coil, is controlled by a foot pedal, and is guaranteed for one year. It consumes 1⅓ kw. per hour that is sufficient for 100 drying operations, and discharges hot air through an adjustable nozzle, causing evaporation and drying thoroughly without possibility of chapping face or hands. It is claimed to be absolutely sanitary and beneficial and costs only about one-tenth as much as towel service.

ARCHER JUNIOR MIXER

The latest addition to the line of concrete mixers, manufactured by the Archer Iron Works, has a batch capacity of 3 cubic feet of wet concrete and is called the new Archer Junior Mixer. It is built along the same general lines of design as the No. 1 Special and 1-bag mixers and embodies the same features of quick loading, portability and end discharge. It is sturdy and reliable with a low operating and maintenance expense and is equipped with a Fairbanks-Morse Bosch magneto 1½-h. p. engine.

A very compact arrangement is made by installing the engine on top of the frame enclosing the mixing drum, thus not only saving space but locating the moving parts where they are in the least danger of disturbance. Considerable advantage is claimed for the low loading platform that is supported on an extension of the mixer frame and permits aggregate to be wheeled onto it and then dumped directly into the hopper, providing an elevation high enough for the drum to discharge into carts or wheelbarrows or onto the surface of the ground, or in many cases to be backed up and discharged over the edge of the form without involving any handling of the concrete. Although conservatively rated at 3 cubic feet the drum has sufficient capacity to take care of ½-bag mix on almost any proportion of aggregate material. The machine, including the loading platform, is quoted at $275 f.o.b. Chicago.



ARCHER JUNIOR CONCRETE MIXER OF 3 CUBIC FEET CAPACITY, WITH LOW LOADING PLATFORM

BLAW-KNOX TRUCK TURNTABLES

The truck turntable made by the Blaw-Knox Co. has a capacity to handle trucks up to 5 tons, and is so compact that it may be placed between the forms on the subgrade for an ordinary width concrete road and still leave clearance for trucks to pass it between the forms, while its own dimensions are such that it revolves clear of the top of the forms. A steel runway to receive the wheels and support the truck is mounted on a circular track with diameter less than the width of the truck, that moves on rollers engaging a lower track and the whole is mounted on skids that provide a foundation for the tracks, spider and pivot pins and enables the complete turntable to be handled as a unit and easily transferred from place to place without injury to the subgrade. It is easily moved by dragging behind a returning empty truck that delivers it to the new position without loss of time or interruption to the paver.

BLAW-KNOX CO.'S TRUCK TURNTABLE

Supports at each end of the turntable prevent the latter from tipping when the truck is driven on it, after which the supports are released by the operating lever, which is then used as a push bar with which one man can revolve a 5-ton truck loaded with 4 yards of material.

The use of this turntable enables the truck to be run at ordinary speed to the point where it is located near the mixer, saves the time otherwise taken to turn the truck and back it perhaps several hundred feet to discharge its load at the mixer, and prevents all confusion of trucks being at the turning point and obstructing the right of way. This reduces time from storage bin to mixer and increases the efficiency of the truck service and of the mixer.

NAYLOR LOCK SEAM SPIRAL PIPE

This pipe, made by the Robertson Bros. Mfg. Co., has a perfectly smooth and accurate interior surface and a special seam that develops strength under pressure and reinforces the pipe, against both internal and external pressure. It can be equipped for slip joints, companion flange, or other styles of connections and is recommended for water supply lines of all kinds, for irrigation, sluicing, and dredging, and for various industrial and commercial and manufacturing purposes. It is made of specially tough steel of 10 to 16-gage in 6 to 24-inch diameters and of lengths up to 40 feet. It can be furnished with a 1/32-inch hot dip coating of 99.3 per cent. pure bitumin. The approximate bursting strength in square inches per pound varies from 141 for the 24-inch 16-gage size to 1,000 for the 6-inch 12-gage, with corresponding weights per linear foot of 17.03 and 10.50 pounds.

PERSONALS

Whitten, Robert H., of Cleveland, has been appointed consulting engineer for the city plan commission of Indianapolis, Ind., at a salary of $4,800 a year.

McCurdy, B. C., has been made county highway engineer of St. Clair county, Ill.

Bartlett, A. C., who has been a member of the city planning commission of Los Angeles, Cal., has resigned to become a member of the board of public service commissioners.

Chambers, A. H., city engineer of Logan, Utah, has resigned.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 March 18, 1922 No. 11

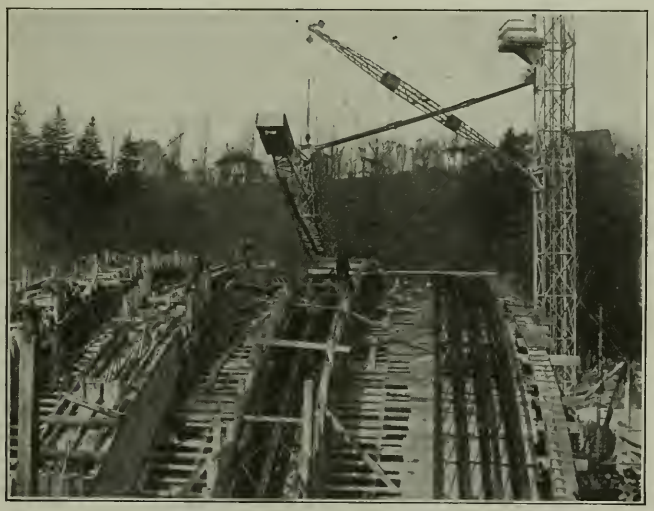
Woodland Place Viaduct

By James Owen*

Ornamental concrete bridge constructed jointly by Bronx Park Commission, City of White Plains, State of New York, and N. Y. C. Railroad. Some features of the plan, specifications, and construction methods.

The public desire now frequently manifested for higher architectural standards in bridge design is exemplified by such structures as the Woodland Place Viaduct now under construction over the Bronx river and Harlem Division tracks of the New York Central Railroad at White Plains, N. Y. In this locality the railroad follows the Bronx river valley which lies betwen roughly parallel north and south ridges. The Public Service Commission several years ago issued an order for the elimination of Tibbets avenue grade crossing over the Harlem Division tracks at this point, and a column and girder viaduct structure was originally proposed for spanning the river and railroad tracks, as shown in one of the accompanying illustrations.

When this plan was under consideration, the Bronx River Parkway Reservation, consisting of a strip of land on both sides of the Bronx river, was being established. As the parkway project includes a motor driveway, and topographical conditions make it necessary for this drive to cross the railroad tracks and valley in the same locality, negotiations were carried out to make the viaduct a joint undertaking of the Bronx Parkway Commission, city of White Plains, New York Central Railroad and State of New York. This co-operative project will result in an overgrade crossing combining Tibbets avenue and



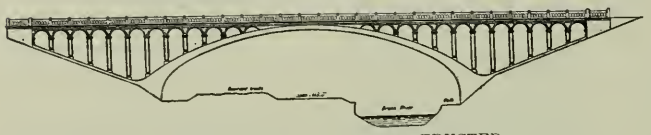
VIEW FROM EAST END, SHOWING REINFORCEMENT, FORMS, AND CONCRETE TOWER AND CHUTES.

*Senior Assistant Engineer, Bronx Park Commission.

the Parkway drive without duplication of expensive structures.

A secondary but important consideration was to get architectural treatment of the viaduct, acceptable to the Bronx Parkway Commission and in harmony with Parkway development in the vicinity. An accompanying illustration shows the adopted design, consisting of an arched span of 145 feet, with a rise of 33 feet. The arch consists of four reinforced concrete ribs tied together with struts to secure the required lateral stability, the reinforcement consisting of latticed, structural steel truss ribs.

PLAN FOR VIADUCT ORIGINALLY PROPOSED.



SECTION OF VIADUCT AS CONSTRUCTED.

The roadway on a gently cambered gradient is supported by spandrel columns which, on the two outer ribs, are spaced by full centered spandrel arches and there is an agreeable treatment of balustrade and lighting details. By the adoption of this design an imposing structure will be secured in striking contrast with the plan originally proposed which had a considerable length of roadway on a 9 per cent. grade. The four arch ribs completed during 1921 by John F. Cogan Co., contractors, now furnish an idea of the appearance of the completed structure as seen through the long valley vistas north and south of its location.

The construction of the viaduct did not develop any problems of note. Satisfactory foundations on hard-pan were found at easy depths below the ground surface. The Bronx Valley sewer 54 inches in diameter passes under the westerly abutment. Piles were therefore driven to carry this abutment, supporting it entirely clear and independent of the sewer structure, with 30-inch footing walls carried down to invert elevation on either side of the sewer barrel, but not in contact with it.

Substantially timbered arch falsework was used and provided a clearance span for the double track railroad line passing through it. Concrete was placed from a steel tower having a boom adjustable to any required elevation for supporting chutes that command the entire arch span, abutments and spandrel columns.

As previously stated, the viaduct when completed will not only serve to eliminate the old grade crossing formerly open at this point but will also provide a valley crossing for Bronx River Parkway Drive. The drive is now paved and open to traffic from Scarsdale to the viaduct, from which it will continue northward to Main street in White Plains and ultimately to Kensico Dam at Valhalla.

The viaduct design and construction have been under the general supervision of Jay Downer, chief engineer of the Bronx Parkway Commission, with Guy Vroman as consulting engineer and in direct charge of the work. The architectural design was furnished by Palmer and Hornbostel of New York. Unless there are unforeseen occurrences, the viaduct should be open to traffic before the end of 1922.

SPECIFICATIONS

As supplementing the above article by Mr. Owen, some of the features of the specifications for this viaduct will be of interest.

The proportions of the concrete were left to be determined by the engineer, but the fine and coarse aggregates were to be measured separately by volume in approved receptacles. The amount of vegetable matter in the fine aggregate was not to exceed 3%, while the coarse aggregate was to contain no loam or clay, but was to be washed if necessary to remove such material, and should all pass through a 2-inch mesh screen.

In order to insure that arches and other portions of the concrete for which it might be necessary could be completed in one operation, complete duplicate mixing and conveying machinery for performing such work was required, and an interruption of more than 15 minutes' duration to continuous placing might be a cause for rejecting the concrete already placed. In addition, material was to be kept on hand for the rapid erection of bulkheads across the arch in case of emergency. It was required that precautions be taken to prevent concrete from becoming dry for at least two weeks, for which purpose frequent spraying, covering with wet cloths or other acceptable means were to be employed, and green concrete was to be protected from hot sun and dry winds.

Where expansion or slip joints might be required, they were to be built with smooth faces coated with cold-water paint or other approved substance or covered by paper or similar compressible material. Where water-tight work was required, the joints were to be grooved and filled with an acceptable, durable, water-proof and elastic cement.

The surfaces of sidewalks were to be given a granolithic finish. A part of the exposed concrete surface was to be pointed or tooth-chiseled or dressed by machine tools producing equivalent effects. The tool dressing was to be carried not nearer than 1-inch to any edge and the edges were then to be rubbed with carborundum stone and washed with water.

The contractor was to bid a lump sum for the falsework, 50% of the bid to be paid to him when it had been erected and the remaining 50% when it had been satisfactorily removed.

The backs of the abutments and portions of the end retaining walls were to be water-proofed, felt being used for this purpose saturated with pitch and weighing not less than 15 pounds per hundred square feet; the pitch used being that known as "straight run coal-tar pitch." The water-proofing was to consist of three layers of felt and four layers of coal-tar pitch, alternating, great care being taken that all the joints in the felt were broken with laps

at least 6 inches wide. The felt was to be rolled out into the pitch while the latter was still hot so as to insure complete adhesion throughout.

A conduit system for lighting cables was built in the viaduct, vitrified clay ducts being used.

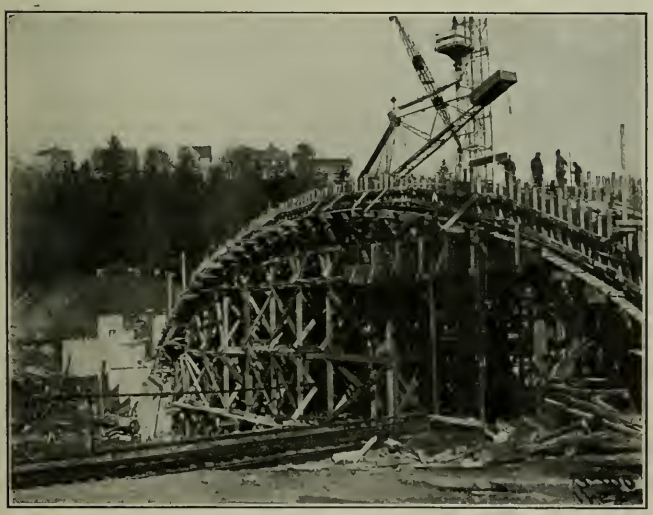
The roadway was paved with asphalt blocks, specified to be 5 inches wide, 12 inches long and 2 inches deep, with a variation of not more than ⅛ inch in width or depth or ¼ inch in length.

CONSTRUCTION NOTES.

Aggregate was delivered by a derrick and clamshell bucket to the hopper bottom storage bin over the Ransome 14-S concrete mixer, which discharged into a hoisting bucket in a Ransome steel tower, 135 feet high with movable boom and receiving hopper, that provided for the delivery of the concrete to the counterbalanced chute, from which it was spouted to position in the forms. The derrick handling the aggregate was installed on the opposite bank of the river from the mixer, which was operated by a steam engine. The location of the hoisting tower near the center of the bridge enabled all parts of the structure to be reached conveniently by the spouting system illustrated by the engravings.

This system was a modification of the one originally proposed, which dispensed with the chute derrick and counterweighted truss, using instead a set of three standard No. 120, one No. 114 and two No. 115 sections of Ransome chutes, suspended from a 1-inch plow steel cable reaching from the top of the hoisting tower to a small auxiliary tower beyond one end of the bridge, and then to an anchorage, and thus providing for the concreting of a little more than one-half the bridge, after which it was proposed to shift the cable and suspended chute to the opposite end of the bridge, thus completing the concreting with a minmum of plant.

The method finally adopted avoided any relocation of plant, and provided for rapidity and convenience in handling the concrete, which, by this method, could be deposited on both ends of the bridge alternately, maintaing a symmetrical loading of the falsework and producing balanced stresses there that would not have been obtained by concreting the span in successive halves.



WOODLAND PLACE VIADUCT, SOUTH SIDE.
Showing falsework over railroad, westerly spandrel columns, and approach fill being placed.

Purifying Tomato-Canning Wastes

Experiments recently completed by the U. S. Public Health Service on the purification of tomato-canning wastes indicate that these wastes and also those from factories packing other vegetables and fruits can be so purified that they may be discharged without nuisance into relatively small bodies of water.

The experiements were begun by the Service at Farnham, N. Y., at the request of a "full-line" canning company, after the company had found itself unable to obtain information from any other source as to methods of purifying its wastes. This factory, however, was burned while the testing plant was under construction, and the tests were carried out at a tomato-canning plant at Amelia, Ohio.

The wastes treated consisted of the liquids from washing down floors and cleaning utensils and apparatus and those from scalding the tomatoes, but did not include tomato cores, skins, or pulp. The solids, including the pulp, which had to be wasted, were hauled away and ploughed into the ground. The volume of wastes treated averaged about one-half gallon per No. 3 can of tomatoes packed (1,000 cans to the ton).

The liquid wastes were pumped to settling tanks, in which about 85 per cent of the solid matter held in suspension was removed and the citric acid of the tomatoes was largely converted into lactic acid.

The solids separated in the settling tanks were disposed of on beds composed of a few inches of sand resting on a shallow bed of cinders. An area of 2.4 square feet will take care of wastes of this nature resulting from each 2,000 No. 3 cans of tomatoes packed.

The effluent from the settling tanks was run through a bed of coarse cinders 4.5 feet deep and later through a bed of sand of the same depth. The rate of filtration through each filter was 75,000 gallons per day.

The effluent from the sand filters was clear and non-putrescible. Fish lived for six weeks in small concrete basins that were supplied only by the filtered waste. Neither odors nor other objectionable features that would militate against the use of tanks and filters near the canning factory were observed.

Milwaukee City Planning

City limits extended and entire area districted according to use, height of buildings, and area of lot occupied by buildings; streets widened, grade crossings eliminated, belt park planned, property acquired for the improvements and civic center located for group of imposing buildings.

In 1916 efforts that had been in progress without much result for seven years secured an appropriation from the Common Council of the city of Milwaukee enabling it to engage engineers and assistants to investigate and design various important plans for the improvement and beautification of the city.

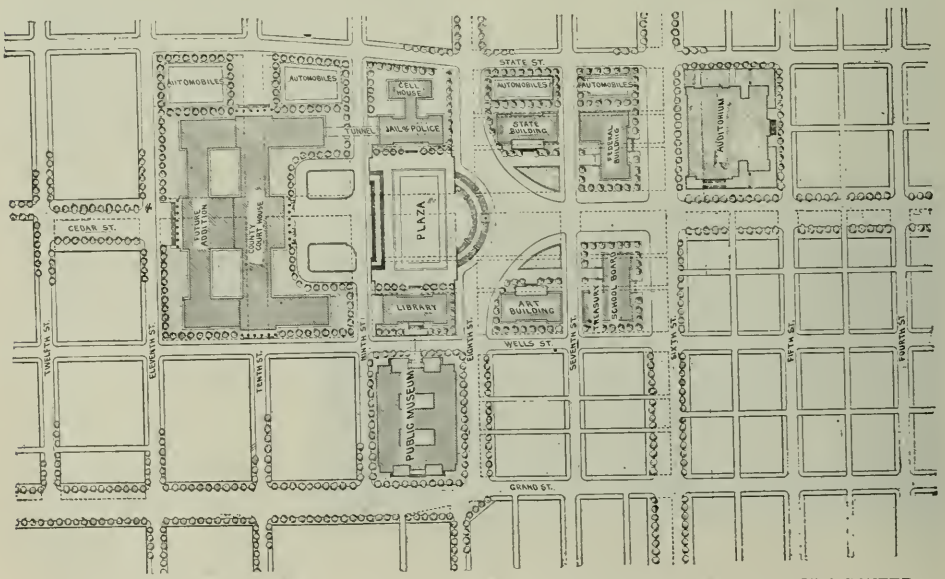
The policy was adopted of concentration of efforts on the execution of a few very desirable improvements and has already resulted in the widening of 15 miles of Oklahoma avenue and Lake street in the outskirts of the city. Most of the grade crossings have been eliminated and the remainder, that have already been ordered by the state railroad commission, will be removed by the expenditure of nearly $4,000,000.

The population of about 500,000 people in an area of 26 square miles is denser than that of any other city in this country and necessitates extension of the city limits which will soon be effected by the addition of several square miles of territory, which has been vigorously petitioned.

A complete survey has been made of the city and of the adjacent territory for three miles beyond the city limits, showing all wooded areas and other lands suitable for parks and playgrounds, which have been mapped to show a parkway surrounding the city and affording a continuous 30-mile drive through the parks and following in large measure valleys of small streams and presenting a beautiful variety of scenery, which will be preserved and enhanced by the municipal ownership and has already been acquired for a proportion of the territory.

The harbor commission is planning the greatest harbor on the Great Lakes, the construction of which is already under way. The acquisition of more land for it has progressed and $1,250,000 worth of additional land has been acquired for it already.

In November, 1920, the Common Council adopted a zoning ordinance prepared by the Land Commission establishing three kinds of districts, according to the use, height and area, to control the character of future construction and occupation. The use district map divides the city into residence, local business, commercial and light manufacturing and industrial districts. Regulations as to height limit the heights of the buildings to 40, 60, 85 and 125 feet respectively in the different districts. The area district map divides the city into four classes of districts in which the area of a lot which may be built upon, is unlimited in the first district, is from 75 to 85 per cent in the second district, from 50 to 60 per cent in the third district and from 30 to 40 per cent in the



PLAN FOR STREET IMPROVEMENTS. PLAZA AND PUBLIC BUILDINGS FOR MILWAUKEE CIVIC CENTER.

fourth district. The ordinance also limits the number of families that may be housed on any lot, and prescribes minimum dimensions of courts and yards to insure sufficient sunlight and fresh air.

The industrial development of the city has also been planned so that in certain districts only temporary homes will be permitted, thus providing for future industrial expansion there. Only necessary improvements will be executed there now, and the area will be left free from the limitations of ordinary city blocks.

A topographic map is to be made of a 36-square-mile area 1½ miles wide surrounding the city, which the county board will zone in accordance with city plans, so as to insure proper development and conformity to the general plan for water and sewer development.

An important feature of the preparatory work of the Land Commission has been the preparation of about 60 large-scale standard maps and plans, including zoning studies and approved districts, maps showing values, growth and building areas in different years and residence development; height and area and use districts; density of population; park and wooded areas; sewer and water systems; arterial highways, main highways, parks and boulevards; residence, business and factory districts; intensive development of business sections; time zone charts; railroad facilities and grade crossing elimination; street grades; location of objectional industries, and various other essential features.

One of the most attractive improvements is the establishment of a great civic center occupying directly and indirectly about 12 city blocks, symmetrically arranged on both sides of Cedar street from Sixth to Eleventh street, involving the acquisition of real estate assessed at $3,500,000 which is now being purchased or to be secured by condemnation to provide for sufficient space for the important buildings and streets and to give the city control of adjacent property, enabling it to resell frontage on the new artery with such property restrictions as will insure the proper development there.

Cedar street is being widened to 180 feet from property line to property line, thus leaving a 100-foot roadway flanked with wide sidewalks and double rows of trees, and forming a main artery leading to a central plaza which will provide a great open air auditorium concentric with the principal municipal buildings, which will be successively constructed with harmonious dimensions and uniform architectural effects. The plaza and adjacent streets will be abundantly provided with shade trees, parking, shrubbery, and flower beds and the lofty and symmetrical buildings will have beauty, individuality and a rich, dignified finish suitable to their public character and imposing arrangement.

This plan co-ordinates with the construction there of the new court house for Milwaukee county and several new municipal administrative buildings that have been authorized and will, when completed, effect considerable economic advantage and expedite and simplify public business.

The buildings immediately adjacent to the plaza will be the library and county jail, on opposite sides, adjacent to wings of the county court house, entirely occupying a third side, while the state building, federal building, art building and educational building form a quadruple group on the court side. Beyond these buildings on one side is a large public auditorium.

Between 8th and 9th streets, opposite the library building, is a public museum which occupies about two-thirds of the block and containing some of the finest and largest of municipal collections, especially including ethnological exhibits of high historical and cultural value and exceptionally important industrial and zoological collections. This museum is at present about fifth in point of size of the museums of natural history and anthropology in the United States. It ranks among the first in its environmental groups and it is embarking upon a very greatly extended program of group building.

It is hoped that activities on the structural operation of the civic center will soon be commenced and prosecuted uninterruptedly, although it is so planned that some of the larger buildings may be built in successive sections, thus affording occupancy long before their ultimate completion.

Large appropriations have been made and probably more will soon be authorized for the principal features of these improvements and $47,000 has been appropriated for the expenses of the Land Commission during the current year.

The surveys, engineering and structural features have been planned under the direction of Roland E. Stoetling, city planning engineer.

The Duties of a City Engineer

The duties which are required of a city engineer vary from merely giving lines and grades in some instances to taking charge of practically all of the physical property and construction operations of the city in others. In a great many cases the various functions of the city engineer are merely added to from time to time by ordinances and in many cases are not even as definitely stated as this.

The city of Sacramento has been operating under the manager form of government since July 1921 and under this form of government the city engineer has charge of the following: planning, opening, constructing, paving, maintaining and repairing all streets, boulevards, alleys, etc.; supervision over the sewers and sewerage system, the crematory and corporation yard, cleaning and sprinkling of streets; charge of the levee system of the city, the city water works and water distributing systems and filtration plant; charge of the construction, maintenance, repair and operation of all public buildings belonging to or used by the city, all wharves, docks, chutes, ships, quays and water front property; the construction and maintenance of fire and police alarm systems and of all buildings and supervision of automobile mechanics in the employ of the city and the enforcement of all rules and regulations pertaining thereto; inspection of all electric wires for furnishing heat, light or power and of the wiring of all buildings hereafter erected in the city and inspection of buildings and issueing of permits for building operation in accordance with the rules and regulations prescribed by ordinance; to which was added on October first the charge of the refuse collection and disposal.

Garbage collection and disposal was not performed directly by the city until October first. Since that time the city has been reorganizing the method of collection and expects to perform this by means of Fordson tractors and trailers in the residence district and by trucks in the mercantile district. The city has been paying about $13,500 a year for operating an incinerating plant and is contemplating closing down the incinerator and disposing of all refuse by burying it in waste land.

Quarry and Steam Shovel Work for Highway Construction

Appliances used by Virginia contractor on nine miles of road work.

The construction of 9¼ miles of a 16-foot highway by the Pace Construction Co. of Roanoke, Va., as contractors involved the excavation of 20,000 yards of earth and the hauling of 60,000 yards of earth a maximum distance of 1,000 feet. A cut was excavated by a Bucyrus 14-B caterpillar shovel, operating in shale rock and delivering from 400 to 500

DITCH DRILLING MACHINE OPERATED BY AIR FROM PORTABLE COMPRESSOR.

loads per day to Western 1½-yard dump wagons, making an average output of 500 yards per day.

The broken stone required for construction was obtained from two quarries at convenient places alongside the road. At quarry No. 1 a daily output of 150 cubic yards was secured by the use of a Sullivan D. P.-53 rotator, making holes up to 16 feet in depth. The drill was operated by air compressed by a Sullivan WK-31 portable gasoline compressor with a capacity of 150 cubic feet of air per minute. A similar compressor was used in the other quarry and to operate the steam shovel, and

QUARRY WITH 150-YARD DAILY OUTPUT.

APPLYING 600 GALLONS OF ASPHALT PER LOAD BY THE FINLAY METHOD.

they were reported by the contractor to be very satisfactory, economical and thoroughly dependable. The stone in quarry No. 1 was crushed by a Western Wheeled Scraper Co.'s crusher No. 2 that had a daily output of 150 cubic yards, and was stored in an Austin 100-ton No. 4 bin.

The best drilling record was 250 linear feet of 1¼-inch holes 16 feet deep in 10 hours. The broken stone was stored in bins that delivered to 2-yard Austin dump wagons hauled by 3-horse teams, which distributed the stone along the road.

The road surface was asphalted by the Finley method, which permits one-half of the roadbed to

BUCYRUS STEAM SHOVEL LOADING WESTERN DUMP WAGONS.

be poured through an offset attachment operated on each side of the 600-gallon tank. The asphalting was executed on a subcontract awarded to Samuel E. Finley, of Atlanta. An average force of 250 men was employed; laborers received $.25 per hour and mechanics received $.30.

Record Snow Removal from North Carolina Highways

A recent snow storm covered the entire State of North Carolina with snow to a depth of 10 to 24 inches. While the snow was still falling Frank Kay, State Highway Commissioner, sent to all of his district maintenance engineers, the following telegram:

"This snow gives you an opportunity to prove the efficiency of your maintenance organization. The condition of your roads two weeks from now will prove how good you are. Let's go."

Although the maintenance organization has been entirely built up during the last few months, each of the 300 maintenance gangs throughout the state, which are equipped with trucks, tractors, road machines, and drags, went into action without any hitch and in practically one day's time succeeded in dragging the snow on the whole of the 6,000 miles of the state highway system, cleaning the roads, and maintaining traffic on them and thus eliminating a

vast amount of delay and expense that otherwise would have been suffered by the transportation interests and the general public.

The direct saving to traffic, large as it is, is almost insignificant in comparison with the great amount of damage that would have been done to the roads themselves had the snow been permitted to remain on them until it melted, which would have injured a large mileage and practically destroyed earth roads by the churning of soft mud under traffic.

In the mountainous districts in the western part of the state, where snowfall is expected at any time, the maintenance gangs have received orders to patrol the roads with the beginning of every fall of snow and to remain at work until the roads are clear. The result is much more important there, than in the eastern part of the state, where the soil contains a much larger proportion of sand.

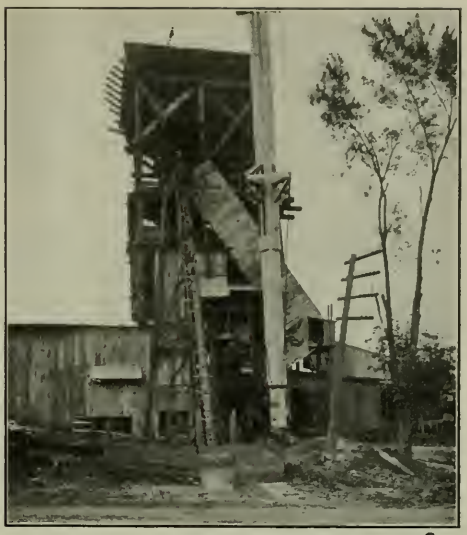
Fifteen Miles of Highway Concreted from a Central Mixing Plant

Sand and gravel brought from pit to screen at mixer by cableway. Maximum speed 700 linear feet a day.

Sections 8, 9 and 10 of Route 5 in Kane County, Illinois, have a 7-inch concrete pavement 18 feet wide and 15 miles long, the contract for which was awarded to the McCall Construction Co., Chicago, for $450,000.

The road is a reconstruction of 9 miles of old gravel surface and 6 miles of earth surface, having a crooked, hilly alignment with maximum grade of 4.85 per cent. and involving excavation of 63,569 yards of earth, which was accomplished by one scarifier and two J. T. Adams grading machines, with 8-foot and 12-foot blades, respectively, and hauled by a Pioneer tractor with wide face wheels which was operated by gasoline and handled about 40 yards of earth per hour.

A central mixing plant was established near the middle point of the section and in it there was installed, in the bottom of the wooden bin tower, a 1-yard Ransome Concrete Machinery Co.'s mixer, supplied with aggregate by gravity from the storage bin in the tower above it.



CONCRETE TOWER WITH ELEVATING MECHANISM AND CHARGING HOPPER

The sand and gravel were excavated from an adjacent pit by a Sauerman cableway excavator installed by the contractor. The trussed mast of the cableway plant was adjacent to the concrete tower and the excavation bucket dumped on a Grizzly over a revolving cylindrical screen, by which the sand and gravel were separated, and falling into a pit, were elevated by bucket conveyors to the storage bins supplying the concrete mixer.

Cement received at a railroad siding 1¼ miles away, was hauled by trucks to the central plant and stored in the 4-car shed adjacent to the mixer.

The concrete mixer was operated by two men and was set a few feet above the surface of the ground so as to deliver directly by gravity to eight Titan motor trucks.

The total amount of about 63,569 yards of pavement concrete was laid at the maximum speed of 700 linear feet per 10-hour day, at a contract price of about $5.68 per yard. There is also about 792 yards of concrete in the culverts, which, like the pavement concrete, was delivered in trucks from the central mixing plant. Water for construction purposes was derived from a driven well 175 feet deep, equipped with an air lift and a centrifugal pump, delivering 350 gallons per minute at the central mixing plant. The concrete was cured by cov-

TRACTOR HAULING GRADING MACHINE AND HANDLING 40. YARDS OF EARTH PER HOUR.

ering with 2 inches of wet earth and the application of a solution of 4 pounds of calcium chloride per square yard of surface.

The work was commenced July 1, 1921, and is now about 40 per cent. completed. It has been carried on with a maximum force of 90 men and an average force of 75 men and, it is expected, will be completed September 1, 1922.

A $60,000 Submerged Pipe Fracture

The Catskill aqueduct of New York delivers water to the Silver Lake reservoir in the Borough of Richmond at a present normal rate of about 14-million gallons daily, through about 10,000 linear feet of flexible jointed 36-inch submerged castiron pipe in 12-foot lengths laid across the Narrows in a dredged trench more than 60 feet in maximum depth, at a cost of about $1,000,000.

Although protected near the Staten Island shore by an earth cover of 20 feet at a point where the water was 30 feet deep above it, the pipe was recently broken, presumably by the spud of a dipper dredge then operating in that vicinity under the direction of the Dock Department. The fracture was indicated by the boiling of the water over the break and by the immediate increase of pumpage to 20,000,000 gallons per day.

Orders were promptly issued for the repair of the injury and within three days the pipe was uncovered by dredging, which disclosed a large hole in one length, which was forthwith cut out in about nine days with two special electric torches, each having a carbon electrode bored for the passage of the cutting gas. Each torch was operated by three divers working in successive 2-hour shifts and cutting a total amount of about 230 linear inches of cast iron, 1⅝ inches thick, 30 inches of heavier metal up to 3½ inches thick and 8 inches of 1½-inch wrought iron. Under the circumstances a progress of 2 inches per hour in cast iron 1⅝ inches thick was considered satisfactory.

Although a special split cast iron sleeve covering two joints and the intermediate section of the pipe had been designed in 1917 for the purpose of effecting repair work, none was kept in stock by the city of New York and as it was estimated to take three weeks to secure one, it was decided to insert a new length of pipe with a cast steel end connection sleeve. The enlarged portion of the spigot end of a standard length of pipe was turned down and the pipe lowered to position with bell enclosing the spigot of the adjacent old pipe and the spigot end was connected to the other end of the old pipe by a jointless steel sleeve 5 feet long previously placed over the old pipe and subsequently moved into position to cover the joint. The sleeve was provided with 12 1-inch bolts 5 inches back from each end that afforded bearings for 2x½-inch collars against which lead wool was calked in the ¾-inch annular clearance between pipe and ring. The calking is held in position by a cast steel gland or collar secured by 9 1-inch bolts to prevent the possibility of a blowout.

Repairs were made at an estimated cost of about $60,000, by the Merritt & Chapman Derrick & Wrecking Co., which originally laid the pipe.

Garbage Collection in St. Paul*

By James W. Routh

Routes, equipment and cost of collection. Arranging routes so as to obtain eight hours' work each day. Adjusting wagon capacity to local conditions.

From the foregoing it will be understood that the city collectors have been employed from time to time to take over routes abandoned by or no longer acceptable to farmer collectors. In fact, those recently added to the city's force have without exception replaced farmer collectors who either have given up routes voluntarily or have been replaced on account of irregular or unsatisfactory service. This method of extending the area served directly by the city's force very naturally has led to little heed being taken of the more or less exact factors which should limit the size of individual routes. The size of the routes was originally determined by the farmers on the basis of the quantity of garbage they desired to collect daily. In consequence the routes are not well balanced and even now there are no accurate data in the hands of the city officers responsible for the work to show the relationship between quantity of garbage, number of collection stops, time required for collection, time required for hauling to disposal points and working speed of collectors.

The farmer collectors obviously must be permitted to define for themselves the size of their routes. So long as they collect garbage without cost to the city or householders it makes no difference what length of working day they observe or how much they collect each day. The sole interest of the city officers is that they shall assume responsibility for certain areas, collect regularly with the desired frequency from those areas and observe the ordinances relating to the transportation of garbage through the streets. It is of importance, however, that the work of the city's own collectors be properly regulated and controlled. These men, who are paid a monthly wage, must be required to observe a certain standard of performance or else the collection costs will become unduly high.

Checks on the operations of the city collectors indicate that these men, on the average, work about five and one-half hours per day. It requires about two or two and one-half hours to collect a load of garbage and about three hours to haul that load to the piggery, unload it and return to the city. The size of the load and the time of collection vary considerably and appear to bear little relation one to the other. This is made evident by Table No. 1. The irregularity of performance of the individual collectors is shown in this table also.

These figures indicate the need for establishing better standards of performance, for readjusting routes and methods so as to utilize the full working day, and for balancing the sizes of routes. The first two requirements can be met, it is believed, only after improved equipment has been installed. They will be discussed below in that connection.

* Concluded from page 179.

The third point, however, may be dwelt upon at more length here.

It is an established fact that the number of premises from which collections can be made in a given length of time does not vary materially from one season of the year to another. In summer and fall when the quantity of garbage produced per collection stop is relatively high, that quantity limits the number of stops per load. If the number of loads collected per day is established on that basis, it will be found that the same number of stops will be visited in the same length of time during the other seasons of the year. The essential thing in garbage collection is that each house shall receive the same number of collections with regularity each week, not that the loads collected shall maintain a certain weight. Therefore, the method of procedure in determining the size of routes is to discover the speed rate of the collectors, the number of premises each one can visit (with the equipment provided) in the time allowed for house to house pick-up. This may be ascertained best during the season of maximum production, since the capacity of the equipment provided and the method of operating that equipment will exert its maximum influence then. With this rate determined, the frequency of collections will fix the size of routes, assuming that the routes represent the work of one week. This size will be constant, for the collector concerned, throughout the year, unless the frequency of collection is changed. When production becomes less, freezing weather and transportation difficulties will tend to maintain the balance.

It has been demonstrated in St. Paul that a good collector visits about 144 premises (residential) in two and one-half hours, collecting one load, during the heavy garbage season. This is at the rate of 1.04 minute per stop and closely corresponds to results obtained elsewhere under similar conditions. During this time there is collected about 1.5 tons of garbage, at the rate of 0.6 ton per hour. This weight rate of collection varies at present between routes and between districts, the latter being determined with reference to disposal points. (See Table No. 2.) Such variation, however, is not of especial significance since, as stated, regularity of time is of greater importance than equality of load weight in garbage collections. Variation in weight-rate of collection is bound to occur with changing seasons, and even from week to week; but variation in time-rate per stop is less excusable and should be reduced to a minimum.

EQUIPMENT AND COST OF COLLECTION

It was stated in the foregoing that the average working day of city collectors now is about five and one-half hours. The conditions under which the work is done, furthermore, fix this length of time, which is not therefore attributable to the men themselves. As stated, the wagon boxes used hold about three cubic yards, which can readily be collected in two and one-half hours during the summer and early fall. The length of haul from loading point to disposal point averages 4.5 miles, which requires about three hours for making the round trip. Hence with the present equipment and methods, the length of the working day is fairly established.

It is obvious that the cost of collection is as high as it is largely because of the fact that the collectors are given eight hours' pay for five and one-half hours' work. (It was in recognition of this that the

TABLE NO. 1

Variation of Hauling and Collecting Time and Load Weight*

Route	Load Weight—Pounds Max.	Min.	Var.	Avge.	Collecting Time—Hrs. Max.	Min.	Var.	Avge.	Hauling Time—Hrs. Max.	Min.	Var.	Avge.	Load Time Max. Load	Avge. Work Day Hrs.
1	1850	1660	11.14	1767	4.17	3.67	13.50	3.92	1.50	1.33	12.8	1.42	3.75	6.76
2	2090	1550	13.00	1911	3.00	2.17	38.20	2.63	1.50	1.17	28.1	1.28	2.50	5.19
3	1675	825	103.00	1405	3.42	2.17	57.50	2.83	2.08	1.92	8.2	1.97	2.33	6.77
4	2175	1300	67.75	1547	2.67	2.33	14.50	2.27	1.33	1.17	13.8	1.23	2.17	4.73
5	1400	980	43.00	1166	2.58	1.83	40.90	2.15	2.00	1.58	26.5	1.78	1.73	5.71
6	1500	735	104.50	925	1.50	1.17	28.20	1.33	1.45	1.25	16.0	1.37	1.42	4.07
7	2125	1400	51.50	1859	3.58	2.50	43.10	3.07	1.50	0.75	100.0	1.01	2.92	5.09
8	2250	1315	71.00	1685	2.17	1.83	18.70	1.97	1.58	1.17	35.0	1.33	1.92	4.63
9	1600	1100	45.40	1350	2.17	1.92	13.00	2.03	1.67	1.42	17.5	1.48	2.17	4.99
10	1575	1100	43.00	1337	3.58	2.58	38.70	3.18	2.17	1.67	28.9	1.87	3.58	6.92
11	1675	1100	52.25	1358	2.42	1.50	61.20	1.93	1.42	1.25	13.6	1.32	2.42	4.57
12	1735	1125	54.20	1618	3.25	2.67	21.80	2.93	1.33	1.17	13.6	1.25	2.92	5.43
13	1400	600	133.50	995	3.08	1.58	94.80	2.53	1.42	1.10	29.0	1.25	3.08	5.03
14	1775	1065	66.70	1338	3.25	1.50	116.50	2.58	1.42	0.75	89.3	1.13	3.25	4.84
15	2225	1125	97.50	1615	3.00	2.25	33.40	2.68	1.75	1.50	16.7	1.30	2.50	5.28
16	1615	1400	15.25	1541	3.00	2.33	28.80	2.68	1.83	1.50	22.0	1.40	2.83	5.48
Avge.	1791	1148	60.79	1463	2.92	2.12	41.40	2.54	1.62	1.29	29.4	1.39	2.59	5.34

*Load weights for season of light garbage. Time factors remain fairly constant throughout the year.

TABLE NO. 2

Rate of Garbage Collection, City of Saint Paul

District	(a) Daily Production Max. Tons	Min. Tons	(b) Load Weight Max. Tons	Min. Tons	(c) Collection Rate per Hour Max.	Min.	Av'ge
I	7.89	3.32	1.58	0.83	0.45	0.24	0.35
II	10.63	4.45	1.18	0.49	0.47	0.19	0.33
III	26.46	10.45	1.46	0.62	0.62	0.27	0.45
Total	45.00	18.22					
Avge.			1.39	0.64	0.51	0.23	0.38

(a) District I hauls to Rauchnot farm; District II, to Green farm; District III, to Northern Stock Co.
(b) Figures are approximate averages for the routes concerned, taken from records of Bureau of Sanitation.
(c) Figures based on reports of Bureau of Sanitation and results of time studies made during August and September, 1921.

collectors on November first accepted a reduction in pay from $185 to $160 per month.) Hence the problem to be solved in Saint Paul is one largely of adjusting methods and equipment so as to obtain eight hours' work each day from the collectors. There is no comparable saving possible from a reduction of pay for fewer working hours, unless the men are paid on an hourly basis. (In the present instance, the reduction of rate of pay by $25 per month does not even approximate the reduced production of the operating force. Reduction of rate of pay, for example, in direct ratio to actual working hours would make the new basis $138.75 per month instead of $160.)

The operation of garbage collection may be divided into two parts: First, the house-to-house pick-up work; second, the hauling to disposal points. (In some cities the latter may be further divided, but this condition does not obtain in Saint Paul.) Economy generally results from a complete separation of the two. One set of equipment and one part of the working force may be used in the pick-up work, and the other in the hauling. This is especially true where the length of haul is reasonably long. In Saint Paul, for example, two and one-half hours are required to collect a load, or to visit and collect from 144 premises, and three hours are required to haul and dump it and return to the starting point. The latter operation, therefore, prevents the collectors from picking up more than one load per day. If they were not required to haul, they could pick up three loads in eight hours. These three loads, in turn, could be hauled to the disposal plants in somewhat less than nine hours. Thus two units of force and equipment might do the work now performed by three.

The next point of inquiry may properly be as to the character of the collection equipment. The present equipment, as previously stated, consists of ordinary wooden boxes mounted on running gear, the box capacity being about three cubic yards. The boxes cannot be dumped (unloading requires about 20 minutes) and they are not water tight. To this extent they do not conform to the minimum requirements which may well be adopted as standard for such equipment, i. e., they should be water tight, steel dump bodies. A further requirement may well be added, that they should be equipped with suitable covers.

The capacity of the wagon boxes must in all cases be adjusted to obtain the best results from the operating force. It is important that the collectors be employed as steadily as possible throughout the working day. It is also necessary that the equipment be of such size that it may readily be maneuvered through the streets and alleys of the city. The one factor tends to increase the capacity, and the other to limit it. For Saint Paul, with the large number of unimproved streets and narrow alleys, it is believed that the second factor limits the effective capacity to about three yards or 3,600 pounds.

When consideration is given the second part of the collection operation, i. e., hauling, it again is evident that economy in hauling requires large loads. The length of haul in the present instance, 4.5 miles average, indicates also the economy of motor equipment for this part of the operation, and this in turn argues again for large loads. A heavy duty truck can haul three loads of the size suggested for the pick-up equipment. This points to the advantage of trailers that may be hauled by teams for the pick-up work and in trains of three or more by trucks or tractors to the disposal points.

The installation of trailer equipment is being considered in Saint Paul and will be made when funds are available for its purchase. The writer has suggested the purchase of 14 trailers of three-yard capacity and of the side-dump type, equipped with wide tires and brakes. These trailers would be operated on seven routes, which would cover the territory now served by the 32 city collectors. They would be operated each unit by two men, collecting from opposite sides of the streets or alleys. This doubling of the collectors with each unit of equipment has been demonstrated to increase the rate of collection per unit by about 80 per cent.

It is estimated that the cost of collection with this equipment and under this plan of operation will be reduced by about one-third, and that the unit cost per ton will approach $4.25 at existing wage rates.

Cement Prices Falling

Bids under $2 a barrel for Portland cement have been received recently by the state highway departments of some of the mid-western states, this being a considerable reduction below bids received by the same states in January. On February 2nd the state highway commission of Indiana asked for bids on 211,544 barrels of cement to be used in constructing 56 miles of the National road from Richmond to Terre Haute. Eight companies competed and five of them submitted identical bids. When Governor McCray learned of this he called the five companies into a conference and informed them that unless the price of cement was reduced concrete would not be laid on the road this year.

On February 28th bids were again received with the result that the prices were reduced more than 20% below the low bid of the previous letting. The Louisville Cement Company was the lowest, offering the cement in sacks at $1.96 a barrel. The Atlas Portland Cement Company offered $1.90 f.o.b. plant, but the Louisville company had the advantage of about 18 cents a barrel in freight rates, the Louisville rate being 42 cents a barrel which will bring the actual cost to the state to $2.36 a barrel, subject, however, to a rebate of 40 cents for return of sacks. The highest bid at the plant in this letting was $2.07.

Bids for cement were also received on the same date in Springfield, Ill., and Madison, Wis., and those in Illinois showed reductions from previous biddings, but in Wisconsin only one bid was reduced from the previous letting. In Illinois offers were made on 4,000,000 barrels of cement at from $1.30 to $1.40 a barrel; the $1.30 being a reduction of 25 cents a barrel from the bid made by the same company on January 8th.

Soon after the first of the year, the highway commissions of five middle western states joined in an agreement to demand lower cement prices, this following the high bids received by Illinois in January, which were rejected. The result of the cooperation is evident from the reductions obtained within two months, as shown by the figures above.

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Conservative Engineering

The award of the contract for building the river section of the New York-New Jersey vehicular tunnel has disposed of a number of important engineering points that have elicited strongly contradictory opinions, without positively settling any of the questions involved except in so far as to make arbitrary requirements for this work.

The design was necessarily difficult on account of the wholly problematical initial volume and rapidity of growth of the traffic, the uncertain features of construction, and the very unsettled condition of labor and material market prevailing when and since the designs were made and since the first estimates were made, which may well account for a very large percentage of variation in the cost, thus involving either an excessively high price to insure the contractor against loss, or heavy gambling on his part on the future state of the market. Estimates have already been materially reduced by delay, and it is possible that a sliding scale of unit prices based on current fluctuations would have still farther reduced the cost while it obviously would have put a large amount of the uncertainty on the owners, where it belongs, and insured a just basis of profit and loss for both contractor and owner.

Very diverse technical opinions prevailed as to the proper diameter of the tunnel, as to the amount of traffic it would receive, as to the desirability of one or two tubes, as to the number of traffic lanes to be provided in each tube, as to the amount and cost of ventilation, as to the materials and methods of construction, and as to location and terminals.

Great difficulties were predicted for the construction of a very large tube and considerable economy for the construction of successive multiple small tubes. A compromise was effected by reducing the maximum proposed construction, but retaining a diameter larger than that of any similar tunnel in this country.

In the principal essentials of design and construction this work will conform to established precedents and there is no room for doubt that it will be executed in accordance with the contract and the official estimate, thus securing high class construction for an agreed price, and removing as much as possible the element of uncertainty from this important public work.

On the other hand an opportunity for developing the methods of tunnel construction and a possibility of important economies with little apparent danger or adverse results for the public has been neglected and no very striking advance in the art is likely to attend the work.

In any event it is an important and interesting construction, in competent hands, which will be carefully watched by engineers and contractors and cannot fail to be of great benefit to the public.

A Large Unnecessary Municipal Bill

Full responsibility should be fixed and adequate penalties imposed for any carelessness or incompetence that can be shown to have caused the wholly unnecessary injury to the submerged water main, delivering the Catskill Aqueduct supply across the Narrows of New York Harbor to the Borough or Richmond, which resulted in a serious menace to Staten Island and requird very expensive emergency work that it is estimated will cost the city $60,000.

The occurrence appears, on the face of it, to be an utterly careless and inexcusable one for which the stockholders of a corporate business would be very likely to demand a rigid investigation. Being, however, only a comparatively small item in the budget of hundreds of millions of dollars expended annually by this city, it is possible that it may not even lead to precautions calculated to prevent a repetition of such carelessness.

This large and expensive water main, vital to the interests and safety of one of the city boroughs, was carefully designed and constructed under competent supervision, and successfully installed and tested in a very difficult and inaccessible position, the location of which was accurately determined and recorded and was under city supervision. A short time ago the pipe sustained a sudden injury, so serious as to throw it wholly out of commission and dangerously cripple the service it had maintained, and which apparently could not have been caused by any inherent weakness in itself, but was apparently due to the

operation of a large dredging machine, which was then in service in the immediate vicinity or possibly in the exact position of the break, and was using heavy anchorage spuds powerfully driven deep in the bottom and entirely capable of penetrating the twenty feet of fill which was the only protection with which the pipe had been provided. No other solution of the accident has been offered, and it is difficult to see how a break of the character described could otherwise have occurred. As both the dredge and the pipe were under full control of the city it may be argued, as in the case of the slave who stole and ate the master's pig, that "no offence was committed since both were the property of the same owner."

Although the possibility of an accident to the pipe had been foreseen and the importance and difficulty of its immediate repair acknowledged by the design of a special sleeve adapted for rapid and advantageous repairs of such a fracture, and although the construction of such a sleeve would take several weeks, not one was held in stock for emergency, and special methods for making the repair had to be designed and applied on the spur of the moment at an estimated cost of $60,000.

Sewage Disposal With Digestion Tank

Editor of Public Works.

Dear Sir:

I have been very much interested in the discussion of Imhoff tanks appearing from time to time in PUBLIC WORKS: and other engineering journals.

It may not be wholly amiss or wholly uninteresting to your readers to state our experience, not with Imhoff tanks, but with an entirely different type.

Our city is small with a normal population between 2,500 and 3,000, and probably about 750 are connected with the city sewers.

Our town is a popular summer resort, so that we have very varying conditions from time to time. Our sewage flow in winter is about 75,000 gallons daily and during the summer from two to three times this amount largely increased at the week-ends.

Our type of tank is a single-story three-compartment tank. Compartments arranged side by side, two settling tanks outside and the digestion tank between.

Settling tanks are 16 ft. by 18 ft. by 16 ft. deep with hopper bottoms with sides sloping at the bottom 1 to 1.

The central compartment is 6 ft. by 18 ft. and 16 ft. deep with hopper bottom.

Two 12-inch inlet pipes take the raw sewage from the by-pass direct to the bottom of each settling tank, if both are in operation, following W. G. Kirchoffer's design. Twelve-inch pipes controlled by gate valves admit the settled sludge from the bottom of the settling tanks to the digestion tank. A scum board extends across the rear of each settling tank about 2 feet from the effluent weir.

There are two scum gates between each settling tank and the digestion tank and a 10-inch sludge discharge pipe extends from the bottom of sludge tank to a point 5 ft. below the top of the sewage in the tanks.

The entire tank is housed in with proper ventilation.

The writer has entire charge of the plant and gives it his personal attention. Once every week the plant is visited and thoroughly gone over as follows:

The digested sludge is drawn, after the drying bed has been cleaned and renewed. The scum is all moved through the scum gates into the middle compartment and thoroughly broken up either with water through a hose nozzle or by hand, which removes the entrained gasses and causes a large part of it to settle. The settled sewage is drawn from each settling tank into the middle tank, the bottom of each tank is flushed through pipes placed around the top of the hopper bottom in each tank.

The sludge is not drawn in winter, neither is water used for breaking up the scum. The above operation is repeated each week and the tank has needed no further attention.

We get an excellent quality of sludge and an effluent that needs no further treatment but is discharged directly into a creek.

The effluent is nearly clear and odorless and shows only a mere trace of sediment after being kept in a bottle for a week.

No life has been found in the effluent, that is, no life that comes from the tank.

We allow no oil wastes and no grease to be discharged into the system, all garages and sinks being carefully trapped.

The writer believes there is more in the care and attention given the operation of any good system than there is in a difference of design. I believe also that frequent drawing of the sludge will prevent a great deal of trouble. We have had no foaming or boiling and the scum never exceeds a few inches in thickness.

We have never removed any scum, but all has been settled and digested. Our dried sludge amounts to about 25 or 28 yards during the season.

Respectfully,

J. G. Skeels,
City Engineer, Lake Geneva, Wis.

Handling Sludge from Imhoff Tanks

About ten years ago Willmer, Minn., installed an Imhoff tank. Since that time many additions have been made to the sewer system but none to the tank, and it is now being operated beyond its estimated capacity. In an effort to save the expense of installing additional tanks during the high prices of the last few years, the city has been pumping sludge from the tank every two weeks throughout the year and apparently with fair success.

There are 580 connections to the system and in addition a few catch basins, which latter should, of course, not be connected with the system, which is supposed to be for sanitary sewers only. There is about 12 miles of pipe.

Since the construction of the plant, with the exception of one year, it has been under the charge of J. A. Rowat as engineer, and at our request he has furnished the information on which this description is based. At present he is using a 4-inch diaphragm pump to pump the sludge from the tank to the sludge bed. As pumped, the sludge contains 80 per cent. to 90 per cent. of water. The sludge bed is made of broken stone about 18 inches deep, underlaid with tile on a good grade. The water drains out of the sludge in about a week, so that it can be hauled in wheelbarrows out of the building which has been erected over the sludge bed.

The sludge is wheeled a short distance where it is removed by farmers living near the city and also by property owners in the city. Mr. Rowat states that he has used it on the lawn at his home for the last four or five years. It is generally spread over the farm or other land by pitch forks, as would be ordinary manure. While the sludge is free, no inducements are offered to dispose of it but it is simply left to be taken by any who desire.

The first few years there were some complaints of odors from the tank, but examination showed that most of them came from another source near the plant and since that time there have been no complaints. The sludge which is used for fertilizer occasionally has a slight odor, but generally it is well decomposed before coming out of the tanks and is not especially offensive.

Recent Legal Decisions

CONDITIONAL FINDING OF COMMISSIONERS HELD NOT SUFFICIENT TO AUTHORIZE ROAD IMPROVEMENT

In mandamus proceedings to compel county commissioners to proceed with a road improvement, the Kansas Supreme Court holds, Herman vs. Larkin, 202 Pac. 980, that under the statute requiring that as a preliminary to the construction of proposed road improvements the county board must find them to be of public utility, where an entry is made upon the commissioners' journal, reciting that it was found that the improvements asked are of public utility, and are ordered made on condition that the road connects with others outside of the country, and that federal aid should be received, this language should be construed as attaching the conditions to the finding as well as to the order, and such a conditional finding is not sufficient to authorize an order for the construction of the proposed improvement. The court said: "To give a basis for hard-surfacing a highway the county commissioners must make an absolute and unequivocal finding that it is of public utility. Naturally in such a case as the present, they will not like to do this, unless it is to be a part of a general system and the usual federal aid is to be had." Although the findings and orders were not effective, however, the commissioners still had authority to proceed; and it was, indeed, suggested by the court to be their duty to take some definite action in the matter.

WATER COMPANY'S RATES HELD EXCESSIVE

In the ascertainment of a reasonable and fair return upon capital used by a corporation engaged exclusively in the business of supplying water to a city and its inhabitants, whose stock and bonds represent money actually employed in the business, the West Virginia Supreme Court of Appeals holds, City of Huntington vs. Public Service Commission, 110 S. E. 102, that the amount of interest annually paid on its indebtedness and the dividends it pays or can pay upon its stock are material and forceful elements to be considered, and it is not entitled arbitrarily to rates which will produce sufficient net income to provide, after payment of all taxes, for 2 per cent. for depreciation and 7 per cent. as a return to it, calculated upon the estimated value of all its property, it appearing that more than two-thirds of the money used in its business is borrowed at the rates of 5 and 6 per cent.

BURDEN ON COUNTY TO SHOW THAT ITS APPROVAL OF WORK WAS OBTAINED BY FRAUD

In a suit by a board of supervisors and a drainage district to set aside the final report of the engineer in charge of the construction of a drainage ditch and the supervisors' approval of the report, and to recover for alleged defects in the work, the Iowa Supreme Court holds, Board of Supervisors vs. Sargent Tile Ditcher Co., 186 N. W. 14, that the burden was on the board to show that the approvals of the engineer and the board were secured by fraud, and that the evidence was insufficient to show the fraud alleged.

STATE BOARD OF HEALTH MAY STOP FURNISHING IMPURE WATER TO COMMUNITY, BUT CANNOT DIRECT PARTICULAR MODE OF DOING SO

The Kentucky Court of Appeals holds, Purnell v. Maysville Water Co., 234 S. W. 967, that, although the State Board of Health has the power to abate a nuisance, source of filth, or cause of sickness, it has no mandatory power enabling it to direct the method by which the result shall be accomplished. It can only cause the abatement of the nuisance, and is not concerned with the method by which it is done. It may stop the furnishing of impure and dangerous water to a community, but it cannot direct a water company to install any particular character of plant for sedimentation, filtration, or chlorination of the water, and the water company may adopt any system that may seem best or expedient to it, if the system adopted produces the results desired—clear, soft, wholesome water. It is therefore held that the board cannot require a water company to install a filtration plant after it has installed a chlorination plant which the undisputed evidence shows has rendered the water wholesome.

COMPETITIVE BIDDING FOR SIDEWALL CONSTRUCTION NOT NECESSARY IN KENTUCKY TOWNS OF SIXTH CLASS

It is not necessary to let contracts for the construction of sidewalks by competitive bidding in towns of the sixth class in Kentucky. Privet v. Shirley, Kentucky Court of Appeals, 234 S. W. 740.

REQUIREMENTS OF NOTICE TO BIDDERS FOR ROAD BONDS

In an action by a county for breach of contract for the purchase of certain road bonds, the Oklahoma Supreme Court holds, McMahan vs. Copiah County, Miss., 202 Pac. 1007, that a notice to bidders for such bonds is not defective because it fails to state the amount of the bonds, the date of their maturity, where they are payable, or the rates of interest they are to bear, where the notice as published refers to the order authorizing the issuance of the bonds. A bid is presumed to have been submitted with full knowledge of everything contained in the order referred to.

LAND OWNED BY CITY OUTSIDE LIMITS NOT TAXABLE UNDER COLORADO CONSTITUTION

In an action against the city and county of Denver for taxes on real property owned by it in connection with its waterworks system outside the city limits, the Colorado Supreme Court holds, Stewart vs. Denver, 202 Pac. 1085, that land owned by a city outside of its limits is exempt from taxation under Const. Art. 10, §4, although it is not necesssary for any municipal purpose, the constitutional provision making no exception, and therefore the defendant's property outside the city limits was all exempt from taxation, although part of it might be unnecessary for waterworks or other municipal purposes.

NEWS OF THE SOCIETIES

CALENDAR

Mar. 20—CONNECTICUT STATE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Taft Hotel, New Haven.

Mar. 21—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Hydro-electric symposium.

Mar. 22-23—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. 15th annual convention. Claypool Hotel, Indianapolis.

Mar. 22-23-24—IOWA ROAD OFFICIALS. Tenth annual conference State Highway Commission's office, Ames, Ia.

Mar. 24—CHICAGO ENGINEERS' CLUB. Annual meeting. Secretary—H. H. Cosley, 110 S. Dearborn St., Chicago.

Mar. 24-25—TEXAS SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. Spring meeting. Fort Worth, Tex.

Mar. 29-30—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting. Urbana, Ill.

Apr. 3-5—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drake Hotel, Chicago.

Apr. 5-6—AMERICAN SOCIETY OF CIVIL ENGINEERS. Spring society meeting. Dayton, Ohio.

Apr. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21—TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 29, Massillon, O.; April 30, Youngstown, O.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 15-19—AMERICAN WATER-WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

NATIONAL CONSTRUCTION CONFERENCE

An important conference will be held under the auspices of the National Federation of Construction Industries at the Drake Hotel, Chicago, April 3, 4, 5, 1922, co-operating with the Federation are the U. S. Department of Commerce, Bureau of Standards, U. S. Department of Labor, Bureau of Labor Statistics, U. S. Bureau of Mines, U. S. Gelogical Survey and the Domestic Distribution and Fabricated Production Departments of the Chamber of Commerce of the United States of America, and all national, regional and local associations of architects, engineers, insurance interests, financial and building loan companies, constructors, builders, sub-contractors, builders' exchanges, material and equipment producers, wholesalers and retailers, executives and workers.

The conference will be held in conjunction with the fourth American Lumber Congress and meetings of other construction organizations.

Preliminary Announcement—Feature 1—A demonstration by displays of associations or individual firms showing "Progress made throughout the industry" in design, research, simplification and standardization of products, or any other developments tending toward a better distribution and utilization of materials, lower productions costs, a more continuous operation of producers' plants, mills and quarries, lower construction costs, successful apprenticeship systems, economies through proper safety measures, and any other developments which have tended to eliminate the wastes of the combined industry. Over 25 associations and individual firms have already advised they will prepare interesting displays.

Feature 2—On the evening of April 5 a great construction industry dinner will be held.

Other special features will be announced.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular business meeting March 1, G. F. Stickney presented the subject of "Siphon Spillways" which was the title of his paper appearing in February "Proceedings." Discussion was led by Edward Wegmann and W. P. Creager, members, Am. Soc. C. E., illustrated by appropriate slides and formed an important contribution to the field of hydraulic engineering.

COLORADO SOCIETY OF ENGINEERS

The Colorado Society of Engineers has elected the following officers for the ensuing year: President, R. M. Hosea; Vice-president, W. M. McMechem; and Secretary-Treasurer, C. M. Lightburn.

MICHIGAN ENGINEERING SOCIETY

The annual meeting of the Michigan Engineering Society, the state assembly of the American Association of Engineers, was held February 8-10 at Kalamazoo. The topics discussed at this meeting included ethics, co-operation in the building field, the highway situation, municipal problems, from zoning and planning to administration by the city-manager form of government and the working out of the registration law.

NORTH DAKOTA CHAPTER, A. A. E.

The following officers were elected by the North Dakota chapter of the American Association of Engineers at its recent convention at Bismarck: President, William Barnes; First Vice-president, J. N. Roberty; Second Vice-president, E. H. Morris; Third Vice-president, George H. McMahon; Fourth Vice-president, J. E. Kaulfuss; Fifth Vice-president, H., C. Frahm, and Sixth Vice-president, R. T. Jacobson.

WASHINGTON SOCIETY OF ENGINEERS

The meeting of the Washington Society of Engineers, held on March 1 at the Cosmos Club, Washington, was addressed by S. S. Arentz, member of Congress from Nevada, on "The Engineer in Politics."

SOCIETY OF INDUSTRIAL ENGINEERS

A meeting of the Society of Industrial Engineers was held on March 14 at the Auditorium Hotel, Chicago. The subject, "Effects of Modern Sales and Advertising Methods Upon Stabilization," was discussed by a general manager of an industry, a sales manager, and an economist or a labor leader.

JOINT ENGINEERING MEETING

The joint meeting of the Metropolitan section with the A. I. E. E., A. S. C. E. and A. I. M. E. at the Engineering Societies Building, N. Y., is to be devoted to "The Port of New York."

PERSONALS

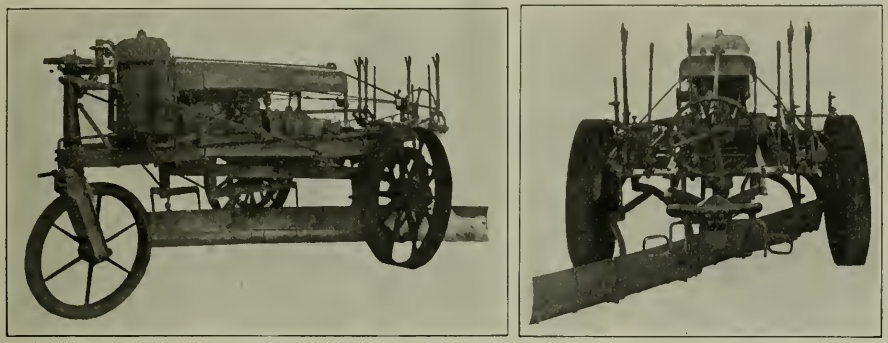
Biles, Geo. H., formerly assistant highway commissioner of Pennsylvania, has been appointed to highway commissioner to succeed Louis F. Sadler, recently deceased. Mr. Biles has been in the Pennsylvania State Highway Department since 1905 and in 1913 became maintenance engineer and organized the present maintenance division in charge of all of the street's completed highways. Mr. Biles has announced his policy of connecting, during the coming season, as many of the already constructed constructions of primary highways as the department's researches will permit.

Johnson, George E., state engineer of Nebraska, secretary of the board of public works and chairman of the Capitol Commission, has tendered his resignation, effective January, 1923.

Brown, R. C., has been appointed acting state highway engineer of South Carolina, to South Carolina, to succeed Charles H. Moorefield, resigned.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



REDUCED SIZE AVERY COMPANY'S ONE-MAN ROAD RAZZER, SHOWING BLADE IN UP AND IN DOWN POSITIONS.

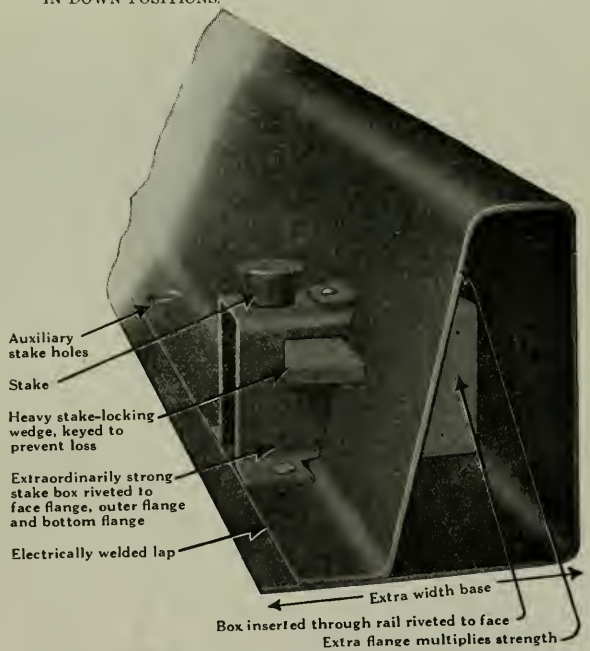
NEW SIZE ROAD-RAZER

In order to provide a machine for making a smooth surface on narrow rough roads, the Avery Company has just put on the market a new reduced size one-man road-razer with a three-section blade, 10 feet 3 inches long, that cuts an area 7 feet wide and is intended to operate successfully on narrow roads and streets without interfering with traffic. The design is like that of the original Road-Razer, except for the reduced dimensions and it is of simple, sturdy construction, calculated for durability, efficient service, and small maintenance cost. It is operated by the driver seated in the rear over the cutting blade, is provided with spring adjustments, and is easily steered through a mitre gear, swinging the castor-like single front wheel.

METAFORM ROAD RAILS

The Metaform Road Rails, manufactured by the Metal Form Corp., Milwaukee, are stiff tubular forms for concrete roads, pavements and foundations. They are designed and built to afford the most durable, permanent equipment and to withstand misuse, having unusual initial strength afforded by tubular construction, box bracing, and extensive riveting, and electric welding.

The joints are so constructed that two or more rails can instantly be lifted out. The extra wide bottom flange width, 5¼ inches, gives a large area of bearing surface on soft ground; the stake boxes are riveted to the rails in three places, and the stakes themselves are secured by locking wedges. Additional stake holes are provided between the boxes. The rail is entirely enclosed so that concrete cannot penetrate the interior. It is made in heights of 6, 7, and 8 inches and in standard lengths of 10 feet. The stakes have special conical heads, facilitating their removal.

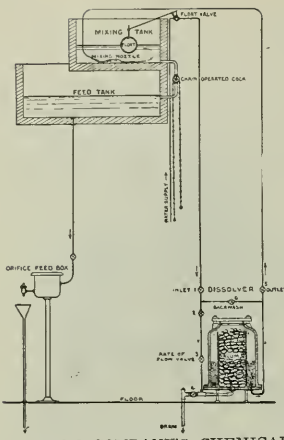

Auxiliary stake holes
Stake
Heavy stake-locking wedge, keyed to prevent loss
Extraordinarily strong stake box riveted to face flange, outer flange and bottom flange
Electrically welded lap
Extra width base
Box inserted through rail riveted to face
Extra flange multiplies strength

METAL FORM CORPORATION'S TUBULAR FORM FOR CONCRETE ROADS, PAVEMENTS AND FOUNDATIONS

CHEMICAL DISSOLVER

This apparatus, sold by the Bannon Company, Ltd., can be used for dissolving various chemicals and is specially recommended for the preparation of alum solutions for water filtration plants where it will eliminate the multiple wooden tanks, stairs, elevated platform, motor, belts, shafting and other apparatus and the inconvenience and labor of handling alum and agitating it by the ordinary process.

Standard dissolvers, with capacities of 1 2 an' 4 cubic feet of substance



BANNON COMPANY'S CHEMICAL DISSOLVER. USED FOR WATER-WORKS FILTERING AND OTHER PURPOSES.

to be dissolved are coated inside with acid-resisting enamel. The dissolver is a pressure resisting, double chambered container, fitted with inlet and outlet pipe connections, operating cocks and rate of flow valve.

A known weight of filter alum being placed in the inner compartment, the inlet and outlet valves are opened permitting a definite number of gallons of water to flow through the dissolver under pressure in a length of time that will insure every particle of alum being dissolved. About 100 minutes is usually allowed to wash every trace of alum from the dissolver.

The filtered solution of varying strength is piped, under pressure, to the mixing tank, where the flow into the tank is through a nozzle, the stream being directed against the floor of the tank. This nozzle creates a violent churning action in the tank which effectively mixes the contents of the tank.

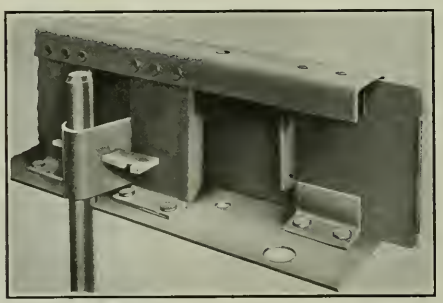
The solution is emptied, by means of a valve, into the feed tank, from which it flows to the orifice box and thence to the coagulation tank.

The dissolver may be located near the alum storage, the mixing tank in any out of the way place (up near the ceiling) and the orifice box wherever convenient for inspection and operation. Whenever the operator happens to notice by the gauge glass that the solution in the feed tank is getting low, he pulls the operating chain and empties the freshly mixed solution from the mixing tank into the feed tank.

The solution is filtered and the orifice cannot become plugged, as is frequently the case with other methods. A float operated valve in the mixing tank shuts off the water supply to the dissolver when the required number of gallons is in the tank. The sand in the dissolver can be backwashed by proper manipulation of the valves.

BLAW-KNOX FORMS FOR ROADS AND STREETS

The steel road forms manufactured by the Blaw-Knox Co. are used for the construction of any kind of concrete road, bituminous surface roads or brick roads, foundations for all classes of roads, curbs, integral curbs, and gutter construction. They have many exclusive features, including: the independence of the separate 10-foot sections which can be removed at any point and at any time without disturbing the adjacent sections; a positive staking system which locks the form securely in the ground and holds it permanently in place to line; the method of hanging the form to the removable stake by means of a heavy wedge or key that insures perfect alignment even in the softest ground; the provision of five special stiffening plates that support the top and bottom flanges; the heavier stakes and wedges and stake straps; and the strongly riveted slip joint connections. All of these features go to give increased durability, strength and efficiency to the forms. The improved C road forms are made of the highest grade No. 9 blue annealed open hearth steel plates of standard length of 5 and 10 feet and heights of 5 to 9 inches with a weight of 9 pounds per foot for the 6-inch size. They can be built up to any required height and the slip joint connections and other parts are securely riveted, making them integral with the form and eliminating loose parts.



BLAW-KNOX IMPROVED C ROAD FORM.

The circular shows details of many different standards and combinations and has half tones of forms installed on several important jobs, one of which, in Arizona, used 25,000 linear feet of them.

RAPID TRENCH DIGGING IN BAD GROUND

A Pawling and Hanischfeger trencher model 152, owned by Charles L. Smith & Sons, Dayton, Ohio, has recently made an excellent record by excavating in 6 hours running time 225 linear feet of trench through very difficult soil containing boulders 2 feet in diameter that were imbedded in flinty flat rock strata, which under the action of the machine broke into sections about 2 feet square and 6 inches thick that were very conspicuous in the spoil banks deposited along the side of the trench, making it resemble an old-fashioned New England stone fence.

These machines are of very sturdy construction, enabling them to successfully withstand the heavy stresses and abuse of extra hard digging and insuring continuous efficient work without delay and expense for frequent repairs, or replacement.

INDUSTRIAL NOTES

Joseph S. Webster & Co., a sales force organized by Joseph S. Webster, of New Haven, Conn., is to represent the Kingsford Foundry & Machine Works, Oswego, N. Y., in the New England states on Kingsford-Webster water-tube boiler sales. Offices will be established in Providence and New Haven.

W. A. Alexander has been appointed district engineer in charge of the Helena, Mont., office of the Portland Cement Association.

C. L. Dewey, who was associated with Carl Akeley in the invention and development of the cement-gun and who has done much work along this line, has joined the forces of the Cement-Gun Construction Co., of Chicago, Ill.

George S. Hedge and Frederic W. Mattheis, dealers in construction equipment, will shortly open offices in Boston, Mass.

The Cummings Machine Co., Inc., Minster, Ohio, announces a change of name to the Industrial Equipment Co., Ind. There will be no other changes as a result of this.

W. F. Jolley has been appointed manager of the London office of the Holt Manufacturing Co., Peoria, Ill., and will have charge of sales of the company's line of tractors in Europe and Africa.

The Worthington Engineering Co., 317 McNnight Bldg., Minneapolis, registered engineers, have reorganized and are specializing in municipal engineering.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 March 25, 1922 NO. 12

Gilboa Dam Construction

Exploration borings, pressure tests, river diversion, foundations, excavation and installation of contractor's plant

The Gilboa Dam, now under construction for a contract price of $6,819,910 by the Hugh Nawn Contracting Co. for the Board of Water Supply, New York City, J. Waldo Smith, Chief Engineer, is being built across the Schoharie creek to impound its waters in the Schoharie reservoir with a capacity of about 22,000,000,000 gallons, as described in PUBLIC WORKS, July 2, 1921.

The Dam will have a concrete spillway section 1,300 feet long, 160 feet high, 15 feet wide at the top and 165 feet wide at the bottom, and an earth embankment 1,000 feet long and 445 feet wide at the base. The principal quantities involved are 90,000 cubic yards of rock excavation, 296,000 yards of earth excavation, 436,000 yards of masonry and 617,000 yards of earth embankment.

During the year 1921, explorations were made of the pre-glacial gorge upstream from the dam by seven holes, aggregating 814 feet in length, and with a maximum depth of 197.5 feet which determined the depth of the bottom of the gorge and that the material encountered is generally impervious, consisting of fine red sand and clay with beds of red and blue clay and occasional pockets of gravel.

A series of pressure tests were completed that were intended to locate rock seams, indicate their connection with each other, and determine the approximate flow through them of water under a pressure equal to the maximum that will be developed after the construction of the dam. These tests show that in general there is considerable leakage in the upper part of the test holes made to explore the subterranean strata, and that the horizontal and vertical seams through which the leakage occurs decrease as the depth increases. No well-defined horizontal leakage planes extending over the entire area were observed, although seams were found in the shale and, better defined, in the sandstone. The results of the tests are shown on a special model which gives the location of seams and the amount of leakage and the connections between them and the geological formation. A study of the results of these tests determined the tentative location and depth of the cutoff trench and of the grout holes, subsequently drilled.

The dam site was protected by up stream and down stream cofferdams, through which two riveted steel pipes 10 feet in diameter carried the waters of the Schoharie creek. The waters of a small tributary, the Steen Kill, were by-passed by means of an artificial canal 10 feet wide at the bottom with side slopes of 1 on 2, a length of 300 feet, and a grade of 20 per cent., which was excavated with a steam shovel and drag scraper and surfaced by a grouted pavement 18 inches thick. Seepage was prevented by four cutoff walls at both ends and at two intermediate points. The 1:3 grout was mixed in a one-bag batch concrete machine, dumping into a mortar box, from which it was dipped by pails and poured into place on the paving, with which it kept close progress.

EARTH EXCAVATION

The earth in the foundation pit for the main dam was excavated by a steam shovel that delivered to 4-yard cars drawn by a dinky engine on a narrow-gage switchback track to the top of the pit and thence to a place where it was deposited in a blanket fill or to a spoil bank. The work was commenced with one shovel, a second shovel was installed April 18, 1921, and both were put on double shifts July 25. A small amount of material was also excavated on the east side of the Schoharie creek and removed by wagons. During the season of 1921, a total amount of 96,000 yards of dirt was excavated from the dam and the spillway channels.

ROCK EXCAVATION

Below the downstream toe of the dam, a sump was made, from which rock excavation was started upstream in a line transverse to the axis of the dam with a trench 10 feet wide, blasted with shallow holes and light charges of powder. The drilling was done by two tripod and two jackhammer drills, and after the completion of the trench, the excavation was carried on from it towards both ends of the dam, the sides of the trench forming faces of the excavation. The rock was blasted in two or three lifts according to the location of the seams, and was removed to an average depth of 6 feet before channeling for the cutoff trench was commenced. Con-

siderable decomposed shale rock was encountered, but became more compact as the excavation was carried into the hill. The muck was at first handled by one steam shovel, four steel derricks and one stiff-leg wooden derrick. The large sound pieces were reserved for cyclopean masonry, smaller pieces were sent to the stone crusher to make concrete aggregate, and waste material was hauled by wagons to a spoil bank.

After the installation of a 10-ton, 1900-foot span cableway in the axis of the dam, the steam shovel was removed and the muck was handled to the cableway by the stiff-leg derrick. The cableway delivered the rock to a hopper that loaded a 4-yard car running on a timber trestle 50 feet long to the rock crushing plant, after which the empty car was hauled back up the incline by a hoisting engine. Rock unsuitable for aggregate was dumped from the trestle into another 4-yard car operated by a hoisting engine that hauled it to the spoil bank. In the spillway channel the excavated rock was handled by a steel derrick and by a stiff-leg wooden derrick.

CUT-OFF TRENCH

So far as completed, the cut-off trench has a top width of 20 feet and a maximum depth of 20 feet and bottom width of 15½ feet with an approximately level bottom surface, rising in steps on the sides of the valley. The sides of the cut-off trench are cut with channeling machines making slots from 8 to 12 feet long and from 4 to 6½ feet in depth, and also by means of drill holes close together made by machines mounted on a quarrybar and subsequently broached by a special non-rotating bit. No blasting is allowed until both sides of the trench have been freed by channel cuts. The channeling has been carried on in one, two and three shifts daily, and was suspended for the season on December 20th.

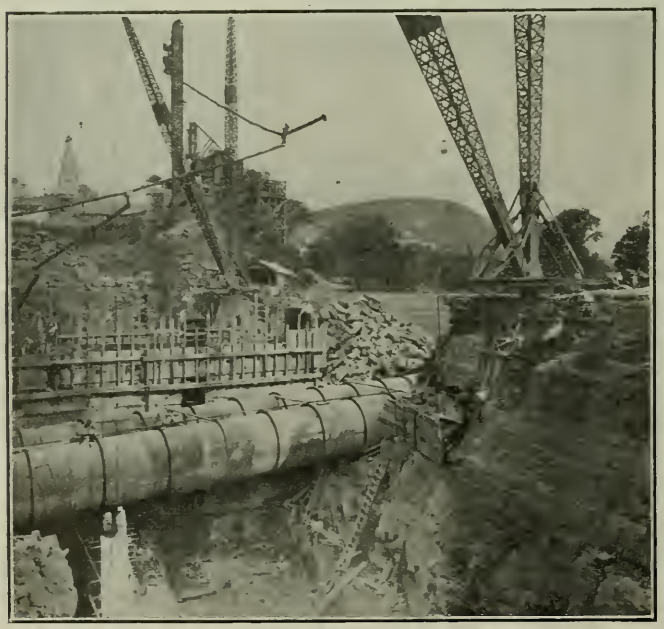
Difficulty was encountered on account of vertical seams and a satisfactory bit was not secured until one having a Z-shape cross section was built up of several pieces of black diamond steel and can be used for periods varying from 10 minutes to 2 hours without resharpening.

Diamond drill holes 2 1/16 inches in diameter were drilled 12½ feet apart on a line 5 feet from the dam line and at an angle 22½ degrees with the vertical. They were carried down to depths of 40 to 50 feet at the center of the gorge and to a less distance on the sides and encountered an artesian flow of subterranean water amounting to 100 gallons per minute. The holes were cleaned with water at 125 pounds pressure from a small perforated pipe lowered to the bottom of the holes. It is expected that grout pumped into these holes under pressure will fill the seams and prevent leakage under the dam.

REMOVAL OF COFFERDAM

Although the crest of the upstream cofferdam was higher than that of the downstream cofferdam, it was, during the year, overflowed six times by floods lasting from 6 to 47 hours and submerging it to a depth of from 1.9 to 3 feet. After the interior of the cofferdam was flooded, it was unwatered by a 6-inch electrical centrifugal pump and a 6-inch duplex pump, after which the interior was easily kept dry by the duplex pump working only a portion of the time.

When there was no longer necessity for the cofferdam, 23 holes were drilled in a 46-foot long section of the lower cofferdam, loaded with 250 pounds of 8 per cent. dynamite and fired, removing that portion of the dam without much disturbance of the adjacent sections. About a week later a corresponding section of the upper cofferdam was blown out with 400 pounds of powder in 30 holes that was exploded with three shots and left a mass of concrete shattered so that it would be removed by the derrick. Afterwards men started cutting out the rivets in the two 9-foot by-pass pipes and they were disassembled.



CONSTRUCTION OF CUT-OFF TRENCH.

PROGRESS OF THE WORK

At the beginning of the year 1921 the $2,000,000 worth of work required to be finished at that time by the contract schedule had been completed and thereafter the progress was somewhat in excess of the contract requirements until the end of the year, when it was more than $100,000 in excess of the $3,000,000 worth then required. During the year the average number of men engaged varied from

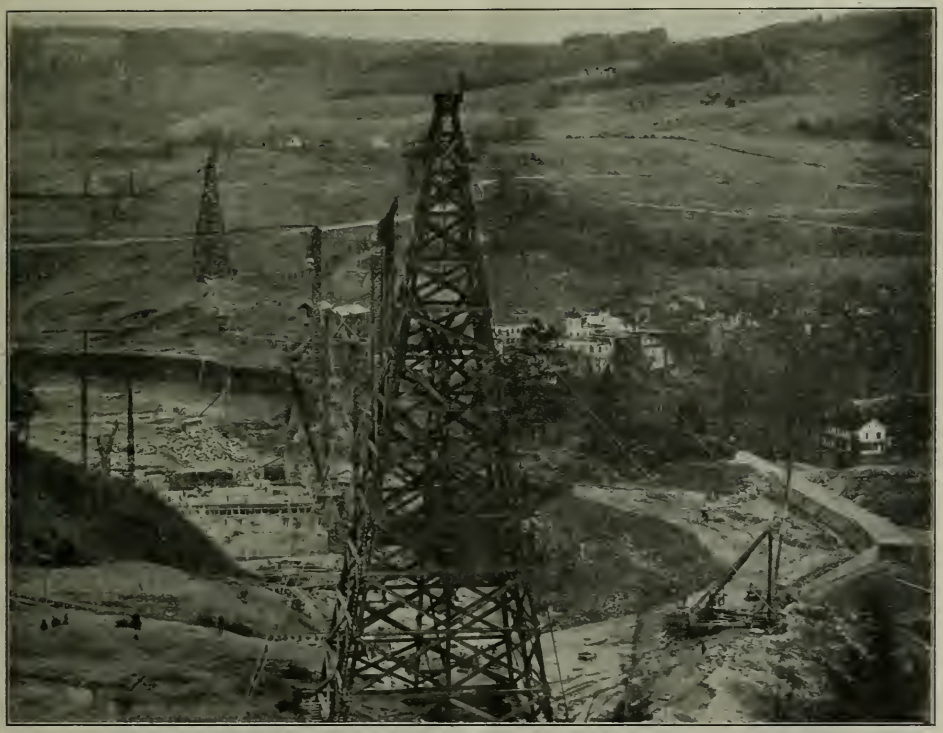
about 100 in January to a little less in December, with a maximum of 540 in September. The number of animals employed varied from 20 to 50.

Work was executed under the direction of Geo. G. Honness, department engineer, James A. Guthridge, division engineer, John D. Groves, senior section engineer, and Louis E. Robbe, section engineer in charge of the dam. Under them, there was a force of 23 assistant engineers, transit men, axe men, inspectors, office employees and others. The contractors' force included N. S. Brock, works manager; James McManus, superintendent, and G. J. Lewis and J. T. Fitzgerald, engineers. The contractor provided dwellings for some of his staff, barracks for the laborers, a commissary and an emergency hospital. The sanitary condition of the camp has been excellent, garbage has been regularly collected and disposed of by burning and by burying in distant pits.

CONSTRUCTION PLANT

The principal items of plant installed for the construction of the dam and for the adjacent roadwork in the reservoir were as follows:

Two Atlantic steam shovels with 2½-yard buckets; four Thew shovels with 2½, ¾ and ⅝-yard buckets; one 42 x 48-inch Traylor Bull Dog crusher; two Traylor gyratory crushers; one 9 x 15-inch Climax jaw crusher; one Climax portable screening and crusher bin; one Austin gyratory crusher; two cylindrical and two cubical concrete mixers with capacities from 6 cubic feet to 2 cubic yards, which were driven by gasoline, steam and electricity; one 10-ton Buffalo roller; one 10-ton Monarch roller; one 12-ton Austin roller; one 20-ton Monarch tractor, and one 2-horse roller; four 15-ton and one 18-ton Dinkey locomotives; twelve vertical and two horizontal steam boilers of 15 to 100 h.p. each; nine Worthington and Warner duplex steam pumps of 3 to 6 inches; five 4 to 10-inch centrifugal electrical driven pumps; three 3-inch diaphragm pumps and four 3-inch hand pumps; two Ingersoll-Rand and one Sullivan channeling machines; twenty-one single and double-drum hoisting engines of the Lidgerwood, Lambert, Lakewood and Mundy types; two Linn 5-ton tractors; one 2-ton Autotruck; two trailers; three Boston caravans; two touring cars; twelve single and five double dump carts; twenty-seven 1½-yard and 2-yard bottom dump wagons; thirty-five 4-yard railroad dump cars; twelve 1½-yard railroad dump cars; eight slip scrapers; twenty 3-yard and six 1-yard skips; six 1-yard Stuebner buckets; several wagons and buggies; fifty-six horses; two water carts; 8,750 linear feet of narrow-gage railroad track; 3,000 linear feet of 50-pound rails; four Ingersoll-Rand air compressors; two portable compressors; three air tanks; four steel guy derricks with 100-foot booms; one steel guy derrick with 90-foot boom; one stiffleg derrick; four travelling derricks with 65 and 75-foot booms; one wooden stiffleg; one wooden guy derrick and two hand crab derricks; one 1,900-foot span cableway on main dam; one stone aerial tramway, 3,670 feet long with ten intermediate towers; one



GENERAL VIEW OF CONSTRUCTION WORK ON GILBOA DAM.
Channel excavation is shown under way at the left.

stone aerial tramway 2,650 long with two 4,100 foot cables and one 7,500-foot cable and three 1 1/9-yard buckets; one 3,300-foot cement aerial tramway with two 3,600-foot and one 6,700-foot cables and 14 1/3 cubic yard buckets, and one 585-foot aerial sand tramway with a 1,400-foot and a 1,200-foot cable and two 1½-yard buckets; two concrete hoisting towers and cables; six 24-inch and one 12-inch belt conveyors; one No. 14 electric driven cyclone well drill; 2,500 linear feet of spiral riveted pipe; 10,000 linear feet of 4-inch air pipe; 200,000 feet of weatherproof covered copper wire; 20,000 feet of hard drawn copper wire; four riveting guns; two chipping guns; three giant air drills; nine Oldham plug drills; one Oldham surface cutting drill; nine tripod drills; fourteen jackhammer drills; two blasting machines; six air augers; eight carbide lights; twenty-two stoves; six sheet pile driving hammers; an acetylene welding outfit; three Caniff grout pans; three 30-ton jacks; fourteen small jacks; a clamshell bucket; an orange peel bucket; 2,000 shovels; 1,000 picks; 5,000 feet of water pipe 1½- and 2-inches diameter; 2,400 feet of 4-inch water pipe; 8,000 feet 6-inch; 2,000 25-W. electric bulbs; two 2½-h.p. gas engines; two 1-h.p. gas engines.

Machine shop No. 1 and Blacksmith shop No. 1 were equipped with a screw machine, lathe, upright drill press, planer, trip hammer, bolt threading machine, bolt cutting machine, hydraulic press, forges and hand tools. Blacksmith Shop No. 2 was equipped with a drill sharpener, forge, electric blower and hand tools. Blacksmith Shop No. 3 had a forge, electric blower and hand tools. Blacksmith Shops Nos. 4 and 5 had portable forges and hand tools. The carpenter shop was equipped with two circular saws, a hand saw, lathe, two planers, jointer, edger and reserve circular and band saws and with hand tools. There were three direct current generators, fourteen electric transformers of 1½ to 333 kva. and 45 electric motors of from 1 to 300 h.p.

State Licensing of Engineers

Summary of the requirements of the laws of the sixteen states that require the licensing of engineers. Who must be licensed and who are exempted.

During the past few weeks we have been collecting, through the courtesy of engineers and other officials of the various state boards of health, the requirements and wishes of such boards in relation to the preparing of plans for sewerage and water works systems and plants, in order that engineers in the various states may know the proper and most desirable procedure when called upon to prepare plans of this kind for municipalities or other communities or public corporations.

The state boards have cordially co-operated with us in this matter, many of them expressing their gratification that we are endeavoring to inform engineers of their regulations and wishes, believing that it will make for more cordial relations between the boards and the engineers and avoid friction which sometimes arises from lack of knowledge on the part of the engineers as to the regulations of the health boards. In collecting this information we originally had in mind the consulting engineers who are called upon to practice in many states other than that in which they live, but found that a great many engineers, either consulting or engineers of cities and smaller communities, are ignorant of the health regulations of their own state.

One of the first regulations of engineering to be considered is the State regulation found in many of the states requiring the licensing of engineers. We are, therefore, presenting as preliminary to a consideration of state health board regulations, a summary of the requirements of the license laws of the several states. While we were still engaged in preparing this we obtained a copy of a compilation of these laws made by the American Association of Engineers, and desire to give credit to this compilation for assistance in perfecting this brief summary.

STATES REQUIRING LICENSES

Up to the present time, sixteen states have passed laws requiring the licensing of engineers, most of the states including also surveyors and some of them architects as well. These states, in the order in which they passed the engineering license laws, are as follows: Florida, Iowa, Michigan, Louisiana, Virginia, North Carolina, Arizona, Indiana, Colorado, Tennessee, New Jersey, Minnesota, New York, Oregon, Pennsylvania and West Virginia. These laws, requiring the licensing of engineers, have already gone into effect in all of these states except Tennessee, where the law becomes effective on April 9th of this year; New Jersey, where it becomes effective in April, 1923; New York, where it becomes effective May 5th, 1923, and Pennsylvania, where it becomes effective June 1, 1922.

THOSE REQUIRED TO BE LICENSED

The law refers to professional engineers in each of these states and in addition, to surveyors in all but Florida, Tennessee, Oregon and West Virginia. In the majority of cases the license is required for either practicing or offering to practice. We understand the distinction between practicing and offering to practice to be that an engineer may, in the states named, endeavor to obtain employment as an engineer without a license, but cannot actually engage in work until the license has been secured.

In addition to engineers and surveyors, a number of states required licenses under the same law for architects.

EXEMPTIONS

There are a number of limitations and exemptions, the most important of which affect those engineers who wish to do work in states in which they do not reside. Tennessee, Oregon and Pennsylvania have exemptions not found in the other state laws, in that their laws do not require registration for the purpose of practicing architecture or engineering "unless the same involves the public safety or health, provided he does not use the appellation architect or engineer," according to the Tennessee law; or for

"other than public utilities, on property owned or leased by said individual, firm or corporation . . . or which affects exclusively the property interests of said individual, firm or corporation, unless the public safety or health is involved" in the state of Oregon, and, in the state of Pennsylvania, registration is not required for practicing engineering or land surveying "by any person or firm or co-partnership or corporation upon property owned or leased by such person, firm, co-partnership or corporation, unless the same involves the public safety or health."

Engineers of the United States government are exempted from the law in Florida, Iowa, North Carolina, Arizona, Indiana, Colorado, Tennessee, New Jersey, Minnesota, New York, Oregon, Pennsylvania and West Virginia. Exemption is also granted to employees of corporations engaged in interstate commerce, such as railroads and others, except in Florida, Iowa, Louisiana, Virginia, North Carolina, Arizona, Indiana, Colorado, Minnesota, New York and Oregon.

An engineer may offer his services without first obtaining a license in Indiana, Colorado, Minnesota, New York, Oregon, Pennsylvania and West Virginia. Should work be obtained in these states, however, a license is required unless there is exemption under other clauses.

Most of the states have provisions for those who have recently moved into the state, permitting them to practice immediately upon their taking up residence provided that they apply at once for a license and pay the license fee. Several of the state laws include provisions that engineers in the employ of the state or any political sub-division thereof at the time the Act becomes effective may continue in such employment without a license until the expiration of their term of office. Registration is not required for an engineer serving as an employee of a registered engineer in North Carolina, Arizona, Indiana, Colorado, Tennessee, New Jersey, New York, Oregon, Pennsylvania and West Virginia.

Several of the states have exemptions peculiar to themselves. For instance, in Colorado, registration is not required of an engineer or architect who had been in the practice of his profession prior to the passage of this Act, provided that he does not represent himself as a "registered architect" or "registered professional engineer." The same state exempts performing architectural or engineering work by a person who is not an architect or an engineer and who does not represent himself to be such.

In Virginia, license is not required of an engineer who practices engineering solely as an employee of the state or any political subdivision thereof, or of any corporation, firm or individual when such engineer's time is devoted exclusively to such employment and such engineer does not offer his services to the public generally for hire; also any engineer who does not represent himself as a "registered professional engineer."

In Indiana, license is not required for a "duly elected and qualified county surveyor." In Minnesota, registration is not required of "any person selected by any municipality or public authority to perform public work in the state of Minnesota."

(To be continued)

Sludge Reduction at the Baltimore Sewage Treatment Plant

By C. E. Keefer *

A large part of the sludge is bought from the city by a private company, which dries, grinds and screens it and sells it as fertilizer.

One of the biggest problems that has confronted Baltimore in its treatment of sewage has been the sanitary and efficient disposal of its sludge. At the sewage treatment works there are four settling tanks, in which the sludge is collected. From them it is pumped into 20 sludge digestion tanks, which have a total capacity of 1,171,000 cu. ft. In these tanks the sludge is digested until, at the end of five or six months, the volume has been decreased about 42 per cent, and the sludge no longer has an objectionable odor. It is pumped from these tanks onto sand beds to a depth of approximately 12 inches, where it remains three weeks or longer, depending upon weather conditions, until its moisture content has been reduced to about 65 per cent.

After being removed from the drying beds, the sludge has been disposed of by selling it to farmers and to a reduction company. During the first few years that the treatment plant was in operation, the sale to farmers was large, totaling over 7 600 wagon loads in 1915. At present the sludge is sold for 25 cents a load. Some of the farmers claim that the sludge gives satisfactory results, while others, who have not learned the best methods of applying it, consider it detrimental to the soil.

The farmers now take air-dried sludge together with small amounts of the dried scum from the digestion tanks. Wet sludge containing about 90% moisture is also sold. There is a decided advantage to the farmers in using wet sludge as they can more easily fill their wagons by gravity from a standpipe which has been provided for them. The amount of sludge that the farmers take away, however, fluctuates widely due to weather conditions, the kind of crops they are raising, the price and supply of manure and garbage, or other fertilizers, the labor market, and the ease with which they can haul the sludge from the plant. Recently facilities have been provided so that the farmers have less trouble in loading their wagons with air-dried sludge.

PRIVATELY OWNED REDUCTION PLANT

About the time the sewage treatment works were completed and for some time previous, numerous propositions were made to the city for disposing of the sludge, some of which consisted of the manufacture of soap, producer gas, and fertilizer. In 1916 a 5-year contract was made with a privately owned reduction company for the reduction and final disposal of the sludge. The contract provided that the reduction company would build its own

* Assistant designing engineer, Sewer Division, Highways Department, Baltimore, Md.

plant, and pay 81 cents a ton (2,000 lbs.) for sludge containing, after drying, approximately 15 per cent moisture; no payment to be made, however, if the nitrogen as equivalent ammonia fell below 2 per cent.

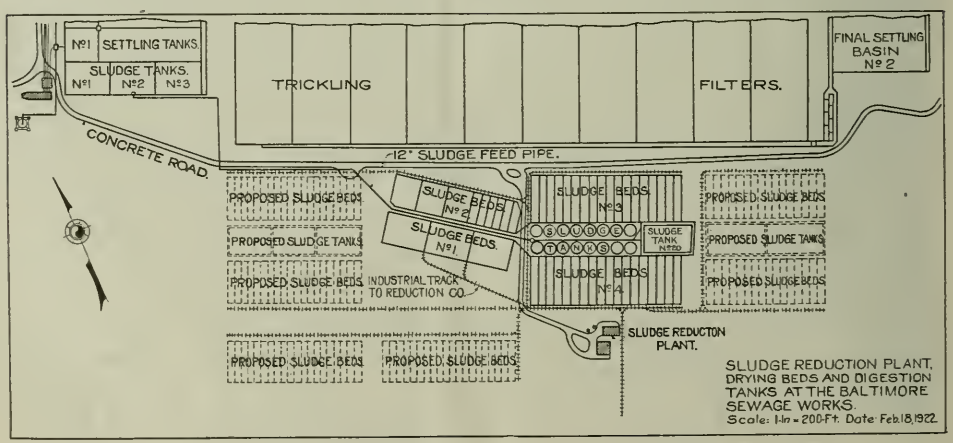
The reduction company is on the property of the city, for which there was an annual rental charge of $250. The plant was situated adjacent to the sludge-drying beds for the convenience of both parties. In the main the plant consists of a hand-fired brick furnace, two rotary driers, and a cylindrical screen. The sludge is hauled on a trestle by a 3-ton Plymouth locomotive from the drying beds in one-yard industrial cars, and is dumped in piles adjacent to the reduction plant. The sludge, which contains about 65 per cent moisture, is then shovelled by hand into a conveyor. This conveyor consists of a trough, which is built on an incline over the top of a furnace. An endless chain, to which are attached blades, 18 in. by 4 in., lifts the sludge so that it falls through the flames of the furnace into the drier. With one drier in operation approximately 4 tons of coal are used per day, and from 14 to 18 tons of dried material are produced. Ten laborers and one superintendent are employed to operate the plant.

Of the two driers at the plant, only one has been operated recently. Both are of the Renneberg make, one being 50 ft. long and 5 ft. in diameter, and the other 40 ft. long and 6 ft. in diameter. Each drier is made of heavy boiler plate. The drier rests on rollers, and is provided with gearing for rotating it, and the sludge which enters gradually works its way to the other end, the drier being built on a slight incline away from the furnace. There are stationary shelves or blades on the interior, which the dried sludge follows. From the drier the sludge drops into a dust box constructed of brick. After leaving the dust box, the sludge is carried through a rectangular trough conveyor to a revolving screen 12 ft. long and 4 ft. in diameter. This screen is covered with wire mesh having 5 openings per inch each way. After passing through the screen, which collects large particles such as match sticks, pebbles, and other large objects, the sludge is carried to a grinder, where small lumps are ground. This ground material is returned to another screen, and is finally put in bags for shipping, each bag when full weighing from 50 to 75 pounds. The dried sludge has a moisture content averaging from 12 to 18 per cent. After drying it averages about 2 per cent of nitrogen as equivalent ammonia, and contains from 4 to 5 per cent of grease. The dried material, since it has a great affinity for water, gives excellent results when it is used as a filler for fertilizer.

When the plant was first put in operation, many difficulties were encountered, and a good deal of experimenting was necessary before satisfactory operating results were obtained. The first cost of the reduction plant was $15,292.64. It had been in service about a year when it was destroyed by fire, and was rebuilt at a cost of $13,037.71. The plant had been in continuous operation since the fire until the contract expired on January 31st, 1921. Table 1 gives the yearly quantities of sludge that have collected in the settling tanks, the amount delivered to the reduction plant, and the amount sold to farmers. Within the past few months the company that owned the reduction plant has made a number of repairs to their machinery, and are continuing to dry sludge by the same methods that they used previously.

At the termination of the contract with the reduction company in January, 1921, several schemes were considered for the final disposal of the sludge. As it accumulates at the rate of 16,000 or 18,000 cu. yds. (65% moisture) per year the problem was a large one. It might have been permissible to dispose of it in the Chesapeake Bay if this body of water had not been one of the centers of the shellfish industry. The cost of carrying it to the Atlantic Ocean, a tow of 170 miles, would have been prohibitive, as it would have been necessary to lay two or three thousand feet of pipe line, to purchase specially constructed barges for holding the sludge, and to dredge several miles of channel to the Chesapeake Bay.

Several of the farmers in the vicinity of the sewage treatment works were interviewed. Some of them said that they found the sludge of value and


Nº1 SETTLING TANKS.
SLUDGE TANKS. Nº1 Nº2 Nº3
TRICKLING
FILTERS.
FINAL SETTLING BASIN Nº 2
CONCRETE ROAD.
12" SLUDGE FEED PIPE.
PROPOSED SLUDGE BEDS
PROPOSED SLUDGE TANKS
SLUDGE BEDS Nº 2
SLUDGE BEDS. Nº1
SLUDGE BEDS Nº3
SLUDGE TANKS Nº2a
SLUDGE BEDS Nº4
INDUSTRIAL TRACK TO REDUCTION CO.
SLUDGE REDUCTON PLANT.
SLUDGE REDUCTION PLANT, DRYING BEDS AND DIGESTION TANKS AT THE BALTIMORE SEWAGE WORKS.
Scale: 1-in = 200-Ft. Date: Feb 18, 1922.

SHOWING LOCATION OF SLUDGE REDUCTION PLANT AT BALTIMORE SEWAGE WORKS.

would buy it, while others showed little interest in using it. From past experience it has been demonstrated that no great reliance can be placed on the quantity that the farmers will take, for which reason some more permanent and sure method of sludge disposal had to be looked for.

The sewage treatment works are under the supervision of A. E. Christhilf, highways engineer, with M. J. Ruark, division engineer of sewers, and J. W. Holden, superintendent of the plant. H. G. Perring is chief engineer of the Department of Public Improvements.

St. Louis' Proposed Water Works

The city of St. Louis, or at least the officials of the water department, have under consideration the construction of additional water works to supplement the present supply. The general design of the proposed works has been fairly well worked out, but the details will not be ready for publication for some time. A vote will be taken on the issuance of bonds for this purpose, the amount asked for being $12,000,000, which is estimated to be sufficient for the first installation.

Some of the general features of the supplementary works, we are informed by Edward E. Wall, water commissioner, are as follows:

The new works will probably be built on the Missouri river and be designed for an ultimate capacity of 200,000,000 gallons per day. Some portions will be built of full size for the completed works, such as the intake, conduits and some of the buildings, also a part of the basins and the grit and mixing chambers. Other portions, of course, can be built a section at a time as the demands develop.

The proposed system is divided into five sections—the river plant, plant equipment, supply mains, reservoir, and service main.

QUANTITIES OF SLUDGE OBTAINED AT THE BACK RIVER SEWAGE TREATMENT WORKS

	Quantities of Digested Primary Sedimentation Tank Sludge Produced in Cubic Yards		Quantities of Primary Sedimentation Tank Sludge Disposed Of				
			Delivered to the Reduction Co., Cubic Yds.	Sold to the Reduction Co.		Sold to Farmers' Loads	
Year	90% Mois.	65% Mois.	65% Mois.	Tons	Mois. %	Wet, 90% Mois.	Dry
1912	6,568	1,877	.....	.....	.....	.....	.....
1913	11,348	3,242	.....	.....	.....	.....	.....
1914	32,233	9,209	.....	.....	.....	5100	.....
1915	47,010	13,431	.....	.....	.....	7178.5	483.5
1916	53,040	15,154	13,631	2527.56	13.87	4048	343.5
1917	51,029	14,580	12,848	1200.09	12.04	847	544.5
1918	64,025	18,293	12,805	3640.09	16.30	316	912
1919	59,886	17,110	16,377	2462.94	16.65	13	.....
1920	57,223	16,349	19,322	1645.69	16.26	564	37

INTERIOR OF ONE OF THE SLUDGE REDUCTION PLANT BUILDINGS.

The river plant includes the land, the necessary protection work on the river, intake, engine house, boiler house, grit chamber, mixing conduit, settling basins, filter plant, and other minor buildings, conduits, etc. The estimated cost of this section is $3,711,000.

The plant equipment includes high and low service pumps with their auxiliaries, boilers, engine shops, locomotives, and filter plant equipment. This is estimated to cost $1,447,000.

The supply main section includes one 72-inch steel main 9 miles long and the land and right-of-way necessary for it. The estimated cost of this is $1,589,000.

The reservoir will be of concrete with a capacity for 100,000,000 gallons and the cost of building this and of the land for it is estimated at $1,130,000.

The service main comprises two 72-inch steel lines each 5 miles long, and cast iron mains necessary for connecting up the distribution system. This and the land necessary for the right-of-way are estimated to cost $3,133,000.

Sand and Gravel Rehandled for Concrete Road

Aggregate stored alongside the subgrade at frequent intervals and delivered to mixer by small trucks, loaded by mechanical equipment.

The 4-mile section of the Edwardsburg highway in St. Joe county, Ind., has a 16-foot surface, 8 inches to 6 inches thick of 1:1 ½:3 concrete placed by the Rieth-Riley Construction Co., Goshen, Ind., contractor.

The aggregate was hauled from South Bend, Ind. in 7-yard trucks, 8 miles over well oiled macadam roads, dumped in stock piles about 2,000 feet apart located by the roadside adjacent to the subgrade either at road intersections or in convenient places along the right of way.

The material was economically transported in large units before the construction season opened, thus practically securing additional working time and permitting the accumulation in advance of a large amount of material available close to the points where it would be used, and consequently reducing delays, uncertainties and interruptions to the work after the paving was commenced.

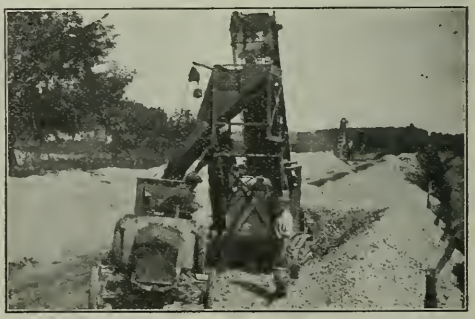
Preliminary distribution was begun before the smooth old road was put out of commission, facilitating the transportation and avoiding injury or extra difficulties that would have been involved by hauling it over the soft subgrade.

Grading was commenced at the end of the section most remote from South Bend and after about 2,000 feet of it had been completed, up to the first stockpile, a Barber-Green loader, equipped with a measuring hopper, was installed at the stockpile and measured and loaded gravel into Lee bodies on Ford trucks, proceeded to the next stockpile and so on. Another Barber-Green loader measured and loaded the required amount of sand into the trucks, five of which were continuously occupied in delivering to the mixing machine, where they backed up and dumped into the charging skip. A sixth truck was kept in reserve in order to maintain full service and avoid interruption in case any truck was temporarily delayed by breakdowns or repairs.

Ordinarily the cement was hauled as needed in large trucks and stored on platforms on the shoulders adjacent to the paver; but when the subgrade was too sandy to carry the heavy trucks, the cement was carried with the sand and gravel, delivered from the stockpiles.

The system of rehandling was found very flexible and economical because with it the materials were cleaned up absolutely at each stockpile, after which the loaders moved to the next piles and without extra cost equalized any variations in the original distributions of material. The cost of rehandling with the smaller trucks was considered to be more than offset by the saving due to making the long haul with large units. This also had the advantage of eliminating delays likely to occur in long-haul operations, and in being flexible and easily adapted to varying conditions as well as making all of the work easily seen and directed by a single superintendent. It also eliminated much of the interdependence of consecutive operations and made the different portions of the work more nearly independent and responsible for their own progress.

The work was executed by 29 men, including covering, 1 man and team for forms, etc., 1 extra man to help team, 1 finisher edger, 1 machine tamper engineer, 1 man in wet concrete, 1 mixer engineer, 1 mixer fireman, 3 cement men, 5 Ford drivers, 2 men on forms, 2 men fine grade, 2 Barber-Greene loaders operators, 2 B-G loader helpers on gravel, 1 B-G loader helper on sand, 1 mechanic, 1 pumpman, and 1 foreman. They made a daily average of 672 square yards or 137 cubic yards in 10 hours, which means that a batch was turned out every 2 minutes and 28 seconds. A maximum of 1172 square yards or 239 cubic yards was laid in 10 hours, which means a batch every 85 seconds. The work was under the direct supervision of Harley A. Firestone.



SAND AND GRAVEL STORED ALONGSIDE HIGHWAY AND DELIVERED TO MIXER BY SHORT-HAUL MOTOR TRUCKS AND TWO LOADING MACHINES.

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Licensing of Engineers

Engineers are divided in their opinions as to the desirability of a system of State licensing of engineers, and substantial arguments are presented both pro and con. New England seems to be solidly against the idea, and a proposed licensing law was defeated in Massachusetts last year, being actively opposed by most if not all engineering societies of the State except the American Association of Engineers. With this exception, however, the sixteen States that have adopted licensing are scattered over the entire country from Arizona and Oregon to New York and Florida, and from Michigan to Louisiana.

The movement for such laws is of comparatively recent development, the first one—that of Florida—having been passed in 1917, and only five having been passed prior to 1921.

These laws require all engineers (except those connected with the army and the railroads) to be licensed before they can practice, although one State exempts those employed by municipalities.

The arguments for licensing are valid, in our opinion, only insofar as they are based upon securing engineering efficiency and protecting the public, and not for use of the license as a method of raising revenue. The former aim depends for its fulfilment upon the employment of informed judgment and common sense in the granting of licenses. That these will not always be employed is evident by the requirements of some of the laws. The Louisiana laws require the granting of a certificate for civil engineering to any one who is 21 years of age, of good moral character and who shall pass a satisfactory examination in "plane trigonometry, plane surveying, practical use of instruments, and in addition thereto, natural philosophy or physics, including practical problems in design and construction." We wonder where the framers of this law obtained their idea of what constituted an engineering education.

To engineers in general practice — consulting engineers—the matter of state licensing presents a problem, for they must take out a license in every state in which they desire to practice. In most of the license states a license must be had before *offering* to practice. It might be thought that this would be met by a reciprocity, as is done in the case of automobile licenses. Each of the states grants a so-called reciprocity in the case of other states whose requirements equal its own. (That would exclude Louisiana from reciprocity with every other state, we hope). But this reciprocity merely exempts the non-resident applicant from examination for a license. He must still take out a license in each state, after presenting legal proof of his possession of a license in his own state, and pay the full license fee in each.

Moreover, each state requires reciprocity. If New York will not recognize a Louisiana license, then Louisiana cannot recognize one granted by New York, and we will have the absurd spectacle of one of the leading engineers of New York, called in consultation by New Orleans, being required to pass an examination in geometry, trigonometry and physics before he can render such service.

The matter of reciprocity will probably be taken up by the National Council of State Boards of Engineering Examiners, when it meets in October, and it is to be hoped that the general adoption of more reasonable provisions in this respect will be arranged for.

Refuse Collection as a Science

Refuse collection is gradually becoming a science —"knowledge classified and made available in work;" but the amount of classified knowledge, or exact knowledge of any kind, is still distressingly meagre. Of quantities as determined by actual weights, measurements and analysis of the refuse collected few municipalities have any records taken even occasionally, and almost none have complete-continuous records. But until such records are available the science of collecting will be a very hazy one and efficiency will depend largely upon chance.

The analysis made of conditions, experiences and costs in St. Paul by the engineer of the Bureau of Municipal Research and published in PUBLIC WORKS for March 11th and 18th is one of the comparatively few studies of this kind which contribute a large part of the fundamental data from which the science of refuse collection must be developed.

In this discussion the author brings out the importance of knowing the exact average time required for making a collection, or the average number of collections per hour, in different classes of districts —sparsely residence, compact residence, business,

etc. Every superintendent of collection could learn these time units for his own city, and if all would do so and make their knowledge public the gain to the science would be great.

Amount of Street Sweepings in St. Louis

By Zara Witkin*

Explanation of greater amounts picked up after rain than in dry weather.

The recent report of the five-year period of suction street sweeping operation in the city of St. Louis in the issue of Public Works for February 4th included data indicating that the amount of street dirt picked up after a rain was greater than the amount removed from the same area in dry weather. This apparent paradox is given at the end of the report in a question asking for an explanation of "the increase of street dirt after a rain."

The explanation given below is based upon a consideration of the probable traffic and pavement conditions and the agents and forces functioning in the deposition, retention and removal of street dirt.

NORMAL OPERATING CONDITIONS

The suction sweeper operated in the shopping districts. The pavement characteristics of metropolitan shopping districts are usually smooth, hard pavement, light grades, well-crowned and maintained surface. Traffic in the same class of streets is usually made up of a minimum percentage of horse-drawn and a maximum percentage of motor vehicles.

Owing to these conditions, street dirt in the shopping districts is composed of a larger percentage of small size fragments or particles than in other heavy-traffic districts.

The data in the St. Louis report referred to dirt removed from the central part of the street, not including the gutter strips, in this case each nine feet wide from the curb. Comparisons were made between dry days and rainy days on the same area.

Assume equal amounts of dirt on this area in the central portion of the street at the same time on different days. (This practical equality is shown by the data.)

FACTORS AFFECTING DISTRIBUTION OF STREET DIRT IN DRY WEATHER

On a dry day three agents are continually at work dispelling this dirt from the central part of the street and distributing it in the gutters, over the sidewalks and building fronts, and into the atmosphere as dust. These agents are:

1. Street cars or motor traffic, which by suction action raise small fragments and dust and throw this material to either side and eventually into the gutters. Every pedestrian is familiar with the automobile's cloud of dust, and its effects. Even the casual observer will notice a marked difference in the cleanliness of the "traffic lanes" as compared with the gutters.

*Engineer, San Francisco Bureau of Governmental Research.

2. Wind, which, on smooth pavement, constantly sweeps the central area and deposits dust, papers, etc. in the gutters and raises some into the atmosphere.

3. The sun, which dries moist street dirt, such as horse droppings, after which traffic breaks it up into fragments and dust, and it is impelled into the gutters as described above.

These three agencies combine to cause a reduction in the amount of street dirt in the central portion of the street from the total amount deposited thereon in dry weather. In wet weather, however, the disposition of this dirt is quite different. None of the agencies considered above are active as in dry weather.

FACTORS AFFECTING DISTRIBUTION OF STREET DIRT IN WET WEATHER

The effects of rain on smooth pavement is to mix with the dirt deposited on it, making a thin, slimy mud which sticks to the surface. This mud is not removed by any but very heavy rains and remains to cause the danger of skidding, to traffic. Of course a very heavy rain does wash away some of the dirt deposited in the center of the street but as a matter of observation this scouring effect is not shown by lighter rains, which serve to moisten the dirt and paste it to the pavement. This is exhibited in the tabular analysis of the St. Louis data.

Analysis of St. Louis Dry Weather and After Rain Pickup Data

	OBSERVATION		
	1	2	3
Cu. yd. picked up, dry weather	2.18	2 11	2.78
Cu. yd. picked up, after rain..	3.92	3.19	3.18
Rain began	..	..	1.30 P.M.
Rain ended	4.00 P.M.	9.00 P.M.	3.00 P.M.
Intensity of rain	..	..	Heavy, 0.81 in.
Sweeper began	8.15 P.M.	1.30 P. M.	7.30 P.M.
Time interval, end of rain to start of sweeping.....	4¼ hr.	4½ hr.	4½ hr.
Cu. yd. difference between after rain pickup and dry weather pickup	1.74	1.08[2]	0.40[1]
Per cent. difference.....	44.3	34.0[2]	12.6[1]

[1]Due to scouring effect of extra heavy rain, not occurring in other cases.
[2]Greater time interval between end of rain and beginning of sweeping, allowing dry weather "removing" agents to take some effect.

The only method which will remove this slime while still wet, is the application of high pressure water streams at a low angle to the pavement surface, by hand hose, or flusher.* Further, traffic tracks dirt from dirtier streets and from the gutters into the "traffic lanes" in wet weather. Rain, in falling, carries down with it the great percentage of the dust in the air, which in a large city exists in considerable amount. Also, the wet surface of the

*Even streams of water under high pressure and directed in accordance with good flushing practice fail to remove a considerable percentage of the dust on the central area of the street. Careful tests made by the Los Angeles Efficiency Commission in 1916 demonstrated this. Their observations under ordinary operating conditions were, for the central strip excluding gutters:
1. That neither horse-drawn nor motor flushers remove all of the dust.
2. The motor flusher removes from 15 per cent to 40 per cent, averaging about 25 per cent of the dust.
3. The horse-drawn flusher removes 45 per cent to 75 per cent, averaging about 55 per cent of the dust. (This is due to the slower speed and consequently greater effective flushing service of the horse-drawn flusher.)

pavement catches and holds the dust which setttles afterwards. Another factor in the greater amount of street dirt picked up after a rain from the center of the street is the quantity of moisture retained in the "dried" particles. On the other hand, the agents which remove dirt from the central area of the street in dry weather do not operate in a rain.

The combined effects of all these factors, operating as described, under normal conditions, will account for the difference in the amounts of street dirt picked in dry weather and after a rain, not as "the increase of street dirt after a rain," but as the amount retained on the central strip of the street by the sticky effect of wetting.

Road Work in Colorado County

The first Texas county to complete its section of the Houston-San Antonio road. Costs and construction details.

Colorado county, Texas, was the first of the several counties through which passes State Highway No. 3, the main line between Houston and San Antonio, to complete its portion of this road. The last section of the road in that county was opened for traffic on January 15th of this year, this section being 3.8 miles long. The entire distance across the county is 40.5 miles. The road is being constructed of gravel 16 feet wide and 6 inches thick, and one mile of concrete 16 feet wide and 5-7-5 inches with 25 pounds of steel per square yard. The road bed is 24 feet wide. The bridges are constructed of concrete.

The road was let in three contracts, the first consisting of 17.12 miles and costing $129,703, including engineering, of which the government paid $44,000, the state of Texas $31,760, and the county $53,943. The second contract was for 19.66 miles, on which the government gave no aid. The third was 3.8 miles and cost $45,761, of which the government paid one-half. The average cost per mile of the first section was $7,576, of the second section $10,715, and of the third section $12,045; the average for the entire 40.5 miles being $9,554.

Two road districts were laid out, divided by the Colorado river, the other boundaries being approximately parallel with the center of the highway and taken at such distance therefrom as not to tax any lands except those which would in most cases receive some benefit. Each district was about 20 miles long by 6 miles wide and had a valuation of about $3,000,000.

Three grade crossings were eliminated by making a change of location of the road and constructing an underpass. The Colorado river is crossed at Columbus by a 700-foot steel span 18 feet wide. The floor of this bridge was made of pine, treated with 10 pounds of creosote to the cubic foot, the flooring being 2 by 4 inches placed on edge. B. H. Faber,

STANDARD CONCRETE CULVERT.

the county engineer, to whom we are indebted for this information, believes that this is the best possible method for constructing timber floors for bridges.

Signs along the road were constructed of steel plates painted and mounted on concrete posts. One of these is placed at each county boundary, giving the name of the county and the distance to the nearest town and a similar one is placed at each town giving the name of the town. These signs are 14 inches by 24 inches and contain white letters three inches high on a black background. Warning signs are placed on each side of the railroad track, made of triangular sheets. Dangerous curves and high embankments are warned against by signs and guard fences are constructed of 6-inch posts of mountain cedar and pine boards 2 by 6 and 4 by 4, painted white.

COUNTY LINE ROAD SIGN

The entire road from Houston to San Antonio is 225 miles long. Of this distance Harris county has constructed a gravel road for 14.2 miles; Fort Bond county contains 35.5 miles, but has raised no special funds for paving it, although county outfits are constructing a dirt road. Wharton county has 12½ miles of bituminous gravel road under construction. Colorado county has 39 miles of gravel and one mile of concrete. Fayette county has 22 miles under construction, and Gonzales has 35 miles of dirt road and a bridge. Guadalupe county has a bridge and has under construction 36 miles of gravel of its 40 miles. Bexar county has under construction 17½ miles.

GRAVEL ROAD; GUARD FENCE IN DISTANCE.

Table No. 1—City Paving Done in 1921

Supplementary data to those published in the issue of February 18th, giving all returns received since the data first received were compiled. The tables will be continued through the next two or three issues.

I—Sheet Asphalt and Asphalt Concrete

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
California:				
Chico	....	.....	177,030*	$0.25
Oroville	....	.....	11,830	.....
Santa Monica	36,828*	$11,818.36	....	.....
Colorado:				
Colorado Springs	....	.....	94,592	2.50
Florida:				
Jacksonville	....	.....	35,938	5.60
Illinois:				
Freeport	....	.....	15,176	57,830.20
Oak Park	33,000	192,000.00	1,963	9,987.00
Indiana:				
Logansport	50,000	5.00	....	.....
Lonisiana:				
New Orleans	7,088	26,807.00	....	.....
South Highlands	....	.....	20,896	3.54
Maryland:				
Baltimore	249,750c	2.40-3.32	....	.....
Massachusetts:				
Boston	2,743	2.25	180,293	2.04
Watertown	11,000	2.60	....	.....
Worcester	....	.....	6,795	24,380.00
Michigan:				
Flint	47,000	.....	....	.....
Kalamazoo	56,800	3.18	....	.....
Muskegon	27,732	.....	....	.....
Saginaw	80,000	403,000.00	....	.....
New Jersey:				
Camden	41,000	155,800.00	....	.....
South Orange	....	.....	4,000	3.59
West New York	....	.....	13,000	3.15
New Mexico:				
Santa Fe	3,000§	.....	....	.....
North Carolina:				
Durham	63,416	279,000.00	....	.....
Ohio:				
Barberton	4,370	15,581.10	1,811	8,243.05
Canton	65,036	249,709.00	....	.....
Dayton	13,500	50,000.00	....	.....
East Cleveland	....	.....	193,630	124,566.00
Newark	42,774.84	197,028.00	6,071.21	21,017.00
Perrysburg	....	.....	25,000	75,000.00
Washington C. H.	16,000	3.23	....	.....
Oregon:				
Dallas	....	.....	9,400	2.53
Pennsylvania:				
Erie	164,608	3.40	....	.....
Philadelphia	363,424	1,202,487.00	....	.....
Sharon	22,181	93,189.00	20,205	75,825.00
South Carolina:				
Union	....	.....	2†	.....
West Virginia:				
Moundsville	....	.....	8,000	.....

II—Warrenite-Bitulithic and Concrete

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
Alabama:				
Birmingham	22,404	.....	2,500	$2.00
Demopolis	....	.....	18,563	3.41
Mobile	....	.....	5,000	.....
Prattville	....	.....	14,000	.....
Tuscumbia	....	.....	12,200	.....
Arizona:				
Chandler	....	.....	18,787	.....
Mesa	11,073	.....	....	.....
Phoenix	150,768	.....	42,440	2.92
Tempe	31,294	.....	....	.....
Yuma	21,000	.....	....	.....
California:				
Avalon	....	.....	4,445	2.61
Bakersfield	....	.....	865§	0.30*
Berkeley	....	.....	1,890	3.15-2.52
Betteravia	....	.....	5,200	.....
Burbank	....	.....	32,416	1.76-1.96
Chico	31,258	.....	....	.....
Colusa	....	.....	2,262	.....
Dixon	21,268	.....	....	.....
El Monte	....	.....	17,996	2.16-2.70
Fowler	13,620	.....	....	.....
Fresno	36,060	.....	24,229	1.80-2.07
Gustine	31,645	.....	....	.....
Hollister	....	.....	67,529	1.71-1.91
Holtville	46,376	.....	....	.....
Inglewood	....	.....	41,029	2.43
Kingsbury	50,016	.....	....	.....
La Jolla	....	.....	6,843	.....
Lodi	36,818	.....	3,000	.....
Long Beach	....	.....	101,986	1.66-2.00
Martinez	60,055	.....	....	.....
Merced	....	.....	20,964	.....
Mill Valley	....	.....	55,710	.....
Modesto	36,802	.....	2,645	1.48-1.78
National City	....	.....	60,371	1.62-1.89
Newman	37,318	.....	1,226	.....
Obispo	....	.....	80,800	.....
Orange	....	.....	55,175	1.56
Orosi	....	.....	7,293	0.90
Oroville	11,830	.....	....	.....
Petaluma	....	.....	4,284	0.80
Paso Robles	65,126	.....	....	.....
Pomona	....	.....	4,888	1.61-1.71
Richmond	....	.....	56,653	106,000.00
Sanoma	....	.....	26,100	.....
San Anselmo	....	.....	2,355	.....
San Buenaventura	57,952	.....	....	.....
San Diego	....	.....	3,717	.....
San Jose	....	.....	6,354	.....
San Pedro	....	.....	33,823	2.97-3.33
San Rafael	....	.....	600	.....
Santa Ana	....	.....	63,828	1.83-3.37
Santa Cruz	....	.....	21,951	.....
Santa Barbara	19,564	.....	12,614	2.03
Santa Maria	....	.....	13,466	.....
Santa Monica	461,139*	.....	6,734	3.18
Seal Beach	....	.....	6,665	2.26
Susanville	23,422	.....	....	.....
Taft	....	.....	10,234	2.43-2.97
Turlock	2,402	.....	67	2.52
Upland	....	.....	3,333	.....
Venice	....	.....	21,922	2.25-3.51
Ventura	....	.....	18,372	1.71-2.09
Visalia	....	.....	121	.....
Vista	....	.....	1,552	.....
Walnut Creek	....	.....	14,002	2.34
Youngstown Tr.	....	.....	39,953	.....
Yuba City	....	.....	76,658	1.79-2.28
Colorado:				
Arvada	....	.....	6,000	2.45
Denver	....	.....	78,101	1.70-3.09
Ft. Collins	....	.....	31,437	2.37-2.46
La Junta	....	.....	30,912	2.56-2.92
Manitou	....	.....	10,971	2.44
Rifle	....	.....	9,972	.....
Rocky Ford	40,621	.....	892	.....
Sterling	63,436	.....	....	.....
Windsor	....	.....	7,042	2.28
Connecticut:				
Darien	....	.....	710	.....
Derby	....	.....	2,600	2.35
Groton	....	.....	5,910	.....
Hamden	....	.....	18,413	.....
Lebanon	....	.....	604	.....
Middletown	....	.....	4,330	.....
Wallingford	....	.....	1,200	1.50
Waterbury	....	.....	1,000	2.74
West Haven	....	.....	2,240	.....
Delaware:				
Delaware City	....	.....	693	.....
Seaford	....	.....	5,360	.....
Dist. Columbia:				
Washington	....	.....	56,351	2.28
Florida:				
Eustis	....	.....	1,000	.....
Pensacola	....	.....	4,000	3.02
Georgia:				
Americus	....	.....	13,488	.....
Atlanta	....	.....	328,355	.....
Augusta	....	.....	71,456	1.74-2.95
Columbus	....	.....	395	.....
La Grange	....	.....	56,600	2.25-2.55
Macon	....	.....	2,729	.....
Marietta	....	.....	62,500	.....
Moultrie	....	.....	468	.....
Rome	....	.....	758	.....
Savannah	....	.....	188,676	2.25-3.33
Idaho:				
Blackfoot	68,415	.....	....	.....
Coeur D'Alene	....	.....	8,260	.....
Filer	....	.....	10,800	4.20
Kimberly	19,219	.....	....	.....
Montpelier	36,621	.....	....	.....
Payette	28,293	.....	....	.....
Rexburg	32,303	.....	....	.....
Wallace	6,733	.....	....	.....

(To be continued)

Recent Legal Decisions

INDEMNITY BY STREET RAILWAY COMPANY TO CITY COVERS INQUIRIES BY ACTS OF INDEPENDENT CONTRACTORS

The Texas Commission of Appeals holds, Northern Texas Traction Co. vs. City of Polytechnic, S. W. 73, that as a municipal corporation has power to control the use of its streets, and as it may become liable to members of the public for any improper condition of such streets caused by those occupying and using them for lawful but unusual purposes, such as street railway companies, it may require indemnity from a street railway company on which to rely in case a cause of action results against it from such use and occupancy. An agreement by a street railway company to indemnify a city, from which it holds a franchise to use the streets, against judgments for personal injuries arising from such use, is not void as against public policy. Such an agreement will cover injuries to a member of the public resulting from the acts or negligence of an independent contractor, while hauling gravel for the street railway, when it is raising its tracks to conform to a change of grade by the city.

WATER BOARD NOT COMPELLED TO REIMBURSE EMPLOYE FOR DAMAGES FOR NEGLIGENT ACTS WHILE NOT ENGAGED IN ITS EMPLOYMENT

The Minnesota Supreme Court holds, State vs. Foote, 186 N. W. 230, that the funds of the board of water commissioners of the city of St. Paul are public funds in the sense that courts will prevent their appropriation for other than the legitimate purposes for which they were intended. A superintendent of mechanical equipment in the city water department, furnished with an automobile for use in the performance of his duties, collided with another automobile while driving to another part of the city where his services were needed. The occupants of the automobile recovered from him damages for their injuries, on the ground of negligence. It was held that the board of water commissioners properly refused his claim for reimbursement, his negligence not having occurred while he was engaged in actual work for the board, or in protecting its property or rights.

"CULVERTS" HELD NOT SYNONYMOUS WITH "BRIDGES"

The Mississippi Supreme Court holds that the state statute providing that boards of supervisors shall construct all bridges in their district costing over $25 does not include culverts, and the highway commissioners are authorized, with the approval of the board of supervisors, to construct culverts out of the district funds. Williamson vs. Hossley, 90 So. 184. The court cited Cleveland vs. Town of Washington, 79 Vt. 498, as holding that the words "bridges" and "culverts" are not synonymous, and Carroll County vs. Bailey, 122 Ind. 46, where it was held that a culvert is not a bridge within the meaning of the statute of Indiana requiring county commissioners to construct and repair bridges over streams and water courses.

STEP TO BREAK DROP FROM SIDEWALK TO STREET, PROPERLY CONSTRUCTED, NOT A DEFECT

In an action for personal injuries sustained while stepping off a sidewalk negligent construction by the city was charged. A drop of 7¼ inches and 5¾ inches, 13 inches in all, existed between the surface of the sidewalk at its outer edge and the surface of the paved roadway. To break the drop, the city had constructed a step or ledge, 13 inches wide, 7¼ inches below the edge of the sidewalk and 5¾ inches above the surface of the street, thus making a double curb. The reason for the unusual drop did not appear. The Ohio Supreme Court holds, City of East Cleveland v. Wald, 133 N. E. 798, that, this being an improved street of a city, the presumption would exist, in the absence of proof, that the street as well as the sidewalk conformed substantially to grades authorized by the legislative body of the city, and that the 13-inch drop at that point was a natural condition. It could not be said that the construction of a step, which was the plan of construction alleged to be unsafe, was any more dangerous than leaving a perpendicular drop of 13 inches. There was nothing hidden or obscured, but, on the contrary, all was perfectly apparent to one approaching and looking downward. Reversing a judgment for the plaintiff, the court cited several cases, Morgan v. City of Lewiston, 91 Me. 566. City of Sumner v. Scaggs, 52 Ill. App. 551, Hoyt v. City of Danbury, 69 Conn. 341, Teager v. City of Flemingsburg, 109 Ky. 746, and Miller v. City of St. Paul, 38 Minn. 134, to the effect that the existence of a step, properly constructed, from a sidewalk to the street, is not a defect, so as to render a city liable for accidents to pedestrians.

CITY COMMISSIONERS' ACCEPTANCE OF STREET PAVING HELD BINDING ON PROPERTY OWNERS

The Oklahoma Supreme Court holds, Interstate Building & Loan Co. v. Oklahoma City, 203 Pac. 172, that where, in compliance with the statute, the city commissioners award a contract for paving city streets, and, on a hearing regularly had for that purpose, adjudge acceptance of the work over the protest of the abutting property owners, such acceptance is conclusive and binding upon the property owners, in the absence of fraud, and where there is nothing more than a dispute as to whether the work has been reasonably well done.

WHAT THE TERM "PAVED ROADS" INCLUDES

The Texas Court of Civil Appeals holds, Gibson v. Davis, 236 S. W. 202, that roads covered with sand or clay or any character of material, so as to make a firm hard, smooth surface over which horses, carriages, automobiles and other vehicles may pass are "paved roads," as that term is used in the state Constitution and laws.

NEWS OF THE SOCIETIES

CALENDAR

Mar. 29-30—ILLINOIS SECTION, AMERICAN WATER WORKS ASSOCIATION. Fourteenth annual meeting. Urbana, Ill.

Apr. 3-5—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drake Hotel, Chicago.

Apr. 5-6—AMERICAN SOCIETY OF CIVIL ENGINEERS. Spring society meeting. Dayton, Ohio.

Apr. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21—TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 29, Massillon, O.; April 30, Youngstown, O.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 15-19—AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

ROCHESTER ENGINEERING SOCIETY

The Rochester Engineering Society was organized March 18, 1897, with 55 charter members of whom 17 are still present. A 25th Anniversary Bulletin was issued, announcing a series of meetings, commencing March 3rd, at the first of which there was presented by Charles E. Ogden motion pictures of the New York Barge Canal that were in February exhibited to Congressmen and Cabinet officers at Washington, in an effort to counteract propaganda of the St. Lawrence Waterway advocates and show the magnitude of the New York State canal.

On March 10th there was an anniversary smoker and regular monthly meeting providing for a sort of big family anniversary celebration gathering of an informal, get-together nature, including reminiscenses of the older members and some stereopticon slides reviewing high points in the society's history.

On the evening of March 18th there was an anniversary dinner indicating the progress of good fellowship and cooperation of the different engineering groups of Rochester, which includes the Society of Architects, Society of Technical Drafting, Rochester Chapter of the American Association of Engineers, American Institute of Electrical Engineers and American Society of Mechanical Engineers, American Society for Steel Treating and the Rochester Engineers Post of the American Legion. There was then an address by John R. Freeman, President of the American Society of Civil Engineers on "Obesrvations in China and the Far East," illustrated with lantern slides, descriptive of his recent travels as consulting engineer on the improvements of the Grand Canal of China. The banquet hall was especially decorated and various prize competition awards were announced on this occasion.

Luncheons were served on March 7th, 14th and 21st, and the speakers were respectively, Charles S. Sterling on the "New York State Canal Terminals;" LeGrand Brown on "Twenty-five years of Engineering in Rochester;" E. R. Foreman on the "Task Ahead for the Rochester Engineering Society;" and J. P. Elston on the "Construction of the Saginaw Hotel," illustrated by lantern slides. The luncheon on March 28th was addressed by Doctor John A. Lloyd on "County Work on Tuberculosis."

A radio meeting will be held March 31st for which special announcements will be made later.

The anniversary programme also announced the regular meeting of the Rochester Chapter of the American Association of Engineers on March 6th with an address by George C. Donahue on the "Progress and Development of Automobile Legislation;" a meeting on March 14th of the Engineers Post of the American Legion with supper and a special stunt programme; a meeting on March 24th of the Rochester Section of the American Institute of Electrical Engineers addressed by H. M. St. John on the "Electric Furnace; the Modern Melting Machine," which described its practical application and touch on some of the illogical and visionary matter which has interfered with its proper development; the Rochester Society of Architects held a ladies' night on March 16th, when an address was given by Henry Warren Poor on the "Domestic Architecture of France, England and Italy," illustrated by more than 200 colored lantern slides from original photographs; and the Rochester Society of Technical Draughtsmen at the regular meeting March 30th will be addressd by Virgil M. Palmer on the "Engineers' License Law—How It Will Affect the Draughtsmen."

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

A joint meeting was held March 15th, in the auditorium, Engineering Societies Building, 33 West 39th street, New York City. The subject was "Development of the Port of New York." It was introduced by E. H. Outerbridge, Chairman, Port of New York Authority, and B. F. Cresson, Jr., chief engineer, Port of New York Authority, and was discussed by E. B. Temple, assistant chief engineer, Pennsylvania Railroad; J. J. Mantell, general manager, Erie Railroad; and Morris Sherrerd, consulting engineer, Newark, N. J., and others.

One of the features of the evening was the showing of a motion picture film of the Port, made by the Port Authority.

A Technical Sub-Section group conference was previously held to discuss "The Importance of the Design of Details, as Evidenced by Recent Theater Failures." Mr. James H. Edwards, assistant chief engineer, American Bridge Company, presided and introduced the subject.

BROOKLYN ENGINEERS' CLUB

At the informal library meeting on Thursday, March 16, "Engineering Aspects of the Elimination of Wastes in Industry," was discussed by J. Parke Channing, Chairman of the Committee on the Elimination of Wastes in Industry, appointed by Mr. Herbert Hoover, President of the Federated American Engineering Societies.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the spring meeting, Dayton, O., April 5th, 6th and 7th, the technical program will commence at the Wednesday morning session with the Address of Welcome, Colonel E. A. Deeds, President, Engineers' Club of Dayton, and Chairman, Board of Directors, Miami Conservancy District, and the response by John R. Freeman, President, American Society of Civil Engineers.

Following there will be technical papers and discussing "Flood Conditions in Canada" by J. G. Sullivan, President, Engineering Institute of Canada, and "The Relation of the Federal Government to National Flood Problems" by Major General Lansing H. Beach, Chief of Engineers, United States Army.

Afternoon Session—"Flood Problems in China," John R. Freeman, President, American Society of Civil Engineers; "Methods of Flood Prevention in the Mississippi Valley," J. A. Ockerson, Past-President, American Society of Civil Engineers, Member, Mississippi River Commission; "Relation of Flood Problems to Power and Irrigation Development in the Rocky Mountain States," A. P. Davis, Past-President, American Society of Civil Engineers, Director, United States Reclamation Ser-

vice; "Flood Prevention Methods on the Pacific Slope," C. E. Grunsky, Vice-President, American Society of Civil Engineers; "Standing Waves in Rivers," N. C. Grover, Chief Hydraulic Engineer, United States Geological Survey, Washington, D. C. Ten-minute discussion led by J. B. Challies, Director, Dominion Water Power Branch, Department of the Interior, Ottawa, Ont., Canada; Morris Knowles, Consulting Engineer, Pittsburgh, Pa.; Harrison P. Eddy, Consulting Engineer, Boston, Mass.; George M. Lehman, Engineer, Department of Internal Affairs for Pennsylvania, Harrisburg, Pa.

Evening Session—"Flood Problems of the Miami Valley and Their Solution," Arthur E. Morgan, former Chief Engineer, Miami Conservancy District; Charles H. Paul, Chief Engineer, Miami Conservancy District; discussion.

April 6th—Excursion to Englewood Dam, by special cars, returning in time to reach the plant of the National Cash Register Company at noon. Luncheon and entertainment at the plant of the National Cash Register Company. Excursion to Huffman Dam, leaving the National Cash Register plant by special cars, returning in time to reach Dayton about 5 p. m. Dinner and smoker at the Miami Hotel. Speaker, Colonel E. A. Deeds, "Human Phases of the Miami Conservancy Project."

April 7th—Inspection of Dayton Channel Improvement Work, leaving Engineers' Club by automobiles and arriving at McCook Field at 10 a. m. Inspection of McCook Aviation Field, leaving the field at noon by automobiles for Union Station. Luncheon and excursion to American Rolling Mill plant at Middletown.

NEW ORLEANS ENGINEERS' CLUB

Engineers of New Orleans have organized an Engineers' Club, which holds luncheon-meetings on the third Monday of each month. At the first meeting in February there were 65 members present representing the American Society of Civil Engineers, Louisiana Engineering Society, American Society of Mechanical Engineers, American Chemical Society and the American Association of Engineers. The following officers were elected: President, O. L. Olsen; Vice-President, J. F. Coleman; Secretary, F. A. Muth, and Treasurer, J. F. Villavasso.

INDIANA ENGINEERING SOCIETY

At its forty-third annual meeting in Lafayette last month the Indiana Engineering Society elected the following officers for 1922: President, A. A. Potter, dean, engineering schools, Purdue University; Vice-President, John L. Elliott, city engineer of Indianaoplis.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA

The Engineers' Society of Western Pennsylvania at its recent annual meeting elected the following officers: President, H. D. Jones; Vice-President, Frederick Crabtree, and Directors, J. C. Hobbs and C. D. Terry.

FEDERATION OF ARCHITECTURAL AND ENGINEERING SOCIETIES OF MINNESOTA

On February 21-23 a joint meeting of the Federation of Architectural and Engineering Societies of Minnesota, which is composed of ten organizations, was held at Minneapolis, at which about 350 members were present. The chief sections to meet were the municipal section, drainage section and highway section, at all of which interesting papers were presented. The new officers are: President, John L. Pickles; Vice-President, C. L. Mott; and Secretary-Treasurer, E. G. Briggs.

OHIO ENGINEERING SOCIETY

The following officers were elected by the Ohio Engineering Society at its annual meeting: President, Robert N. Waid; Vice-President, John N. Leach; and Secretary-Treasurer, John W. Graham.

INDIANA SANITARY AND WATER SUPPLY ASSOCIATION

The fifteenth annual meeting of the Indiana Sanitary and Water Supply Association in affiliation with the State Board of Health was held at the Claypool Hotel, Indianapolis, March 22 and 23.

The object of this association is the study of the Sources of Water Supply in the State of Indiana, their Conservation and Purification.

The program included:

Wednesday, March 22, 1922, 10 A. M. —The president's address by Chas. Brossman. Report of secretary-treasurer by C. K. Calvert. The State-wide Fire Prevention Campaign by Newman T. Miller, State Fire Marshal. Spontaneous Combustion by F. C. Atkinson, Chemical Engineer, Indianapolis, and discussion led by F. C. Jordan, chairman Fire Prevention Committee, Indianapolis Chamber of Commerce. "Fire Service as It Relates to Water Supply," Distribution Systems, Care of Fire Hydrants, Location and Care of Gate Valves, Effect of Raising Fire Pressure was the subject of a Round-Table Discussion, led by Dow R. Gwinn, E. L. Loomis and Howard A. Dill. Appointment of committees.

The Luncheon: Address was made by Hon. Warren T. McCray.

Afternoon Session: Construction of a Ten-Million-Gallon Storage Reservoir, by W. C. Mabee. The Dam and Water Impounding Project at Decatur, Illinois, by J. Albert Holmes. Plans for the Development of Indianapolis, by Ed. B. Raub and L. V. Sheridan, City Planning Commission, and Herbert Foltz, Architect, Indianapolis. Service as an Element in Rate-Making, by Carl Wilde, Director of Service, Public Service Commission. Motion Picture—Manufacture of Modern Welded Pipe; courtesy National Tube Co., Pittsburgh, Pa. Lecture by H. G. Breckenridge.

March 23: The Indianapolis Sanitary District—Refuse Collection and Garbage Disposal, by J. A. Craven. Studies on Stream Pollution, by R. E. Tarbett. A Pollution Index of Indiana Streams, by J. C. Diggs. Investigation of Sanitary Conditions of the Calumet River Drainage Area, by L. A. Geupel. Studies of Water Waste at Indianapolis and East Chicago, by George R. Popp, Jr.

Afternoon Session: Round-Table Discussion—"Water Works Building Programs in Indiana," led by J. B. Marvin, B. J. T. Jeup, J. W. Toyne, Charles Streithof, G. G. Blockie, J. O. Endris and Frank L. Dix. Periodic Forecasts of Desirable Water Works Betterments, by Leonard Metcalf. Testing for Iron Removal from Water Supply of Benton Harbor, Mich., by Paul Hansen. Review of East Chicago Filter Operation and Waste Reduction, by E. J. Jenkins.

BROOKLYN ENGINEERS' CLUB

At the March 23d meeting a paper on Compounding the Combustion Engine, illustrated by Lantern slides, was presented by H. J. Scharnagel, chief engineer of the Engine Department of the Sperry Gyroscope Company.

PERSONALS

Graham, Matthew, has been appointed superintendent of the municipal waterworks of Leavenworth, Kans.

Fielder, Joseph A., for four years superintendent of the Steubenville, Ohio, water works, tendered his resignation on January 31st.

Dale, William P., has been appointed township engineer and road superintendent of the township of Stamford, Ont.

Buetow, W. C., has been promoted to the position of bridge engineer of the Wisconsin Highway Commission.

Brumby, James R., Jr., of Mariette, Ga., has been appointed city manager of Ocala, Fla.

Mattis, George, has tendered his resignation as city engineer and superintendent of streets of Oakland, Cal.

Brouk, James A., has been appointed city manager of Pawhuska, Okla.

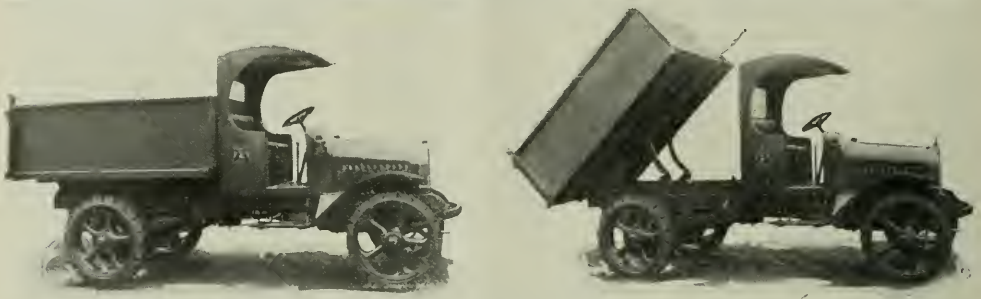
Thomas, Fred W., has been appointed city engineer of Logan, Utah, to succeed Alma H. Chambers, resigned.

Sillyman, Walter A., of Altoona, Pa., has been elected engineer for the Cambria county commissioners, Ebensburg, Pa.

Wood, Julian P., has been elected superintendent of the water and sewerage department of Marlboro, Mass.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



HOUGH MECHANICAL HOIST INSTALLED ON 2-YARD DUMP BODY ON 2-TON CHASSIS.

HOUGH MECHANICAL HOISTS

This appliance, made by the Hough Mechanical Hoist Co., in a 3-ton size, will operate a 2-yard dump body on a 2-ton truck chassis. It is operated with an eccentric drum and segmental pivoted struts and takes the power from the transmission. It can be installed on either side of the truck chassis and has immense lifting power, due to the 4-inch radius of the eccentric drum.

NEW AVERY ROAD ROLLER

The accompanying illustration shows the new Avery Road Roller attached to the Avery 45-65 H. P. Road Tractor.

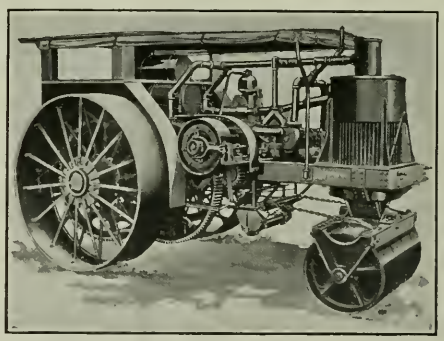
The Avery Road Roller has the same wheel base as the Avery Tractor and sets directly under the front end of the machine in place of the front axle. The tractor will turn around as short with the roller as with the axle. The turntable is mounted on ball bearings. It has about 75 1-inch hardened steel balls that carry the roller and therefore is claimed to turn much easier than the ordinary tractor.

This machine makes it possible for road builders and contractors to roll and pack a road as they grade it.

The idea in furnishing a roller with the tractor is to pack the road as it is built, not leaving the packing to the traffic, which only acts in spots. When a mile of grading is finished with a tractor roller, the sponge qualities of the road have been eliminated and the materials packed harder than by a year of travel.

The tractor with the roller is 9 feet wide and exerts an average pressure of 175 pounds per square inch on the road surface, which means treating every inch of the road six times with a pressure of 175 pounds to the inch, which settles the road, fills up air pockets and spaces that would hold water, makes the road solid and firm next to the ditch, so that the full width of the road is available for traffic instead of a small section.

In building roads with the roller, no more should be opened up than can be finished each day, so that night rains have no more effect on the road than on a road that has had months of travel.



AVERY ROAD ROLLER ATTACHED TO AVERY TRACTOR.

This road roller attachment can easily be removed in less than an hour and wheels can be put on the machine for use in hauling and other jobs that may require a tractor.

A NEW TRAFFIC MARKER

This improved marker is manufactured by the Mound Traffic Equipment Co. for use at street intersections and safety zones. It is constructed to allow automobiles to pass over it without injury to marker, cars, or pedestrians.

The marker is installed on the pavement and stands only 7 inches high above it. The top of the mound shaped marker is one lens designed to throw horizontal beams of light in all directions and secure maximum visibility by night and by day.

It is superior to ordinary tall safety zone signs, because it can, in case of emergency, be run over without injury and because it locates the signal light near the street surface where it is most visible and where the automobile driver's line of sight is directed at a point 100 or 200 feet from the motor, so that it is most readily and probably seen by any driver, and affords him a better opportunity to judge distance than if it were at the same elevation as his eye.

Besides the electric-lighted signal marker the designer has now in process of production a portable day marker for use in places where it is not necessary to maintain night service. This marker is light enough to be easily carried to the sidewalk when not in service and heavy enough to remain in place on the street without fastening. The devices are protected by mechanical and process patents and can be produced at low cost, enabling them to be sold at popular prices. Great durability and efficiency are claimed for them.

THE MOUND TRAFFIC EQUIPMENT COMPANY'S NEW MARKER.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

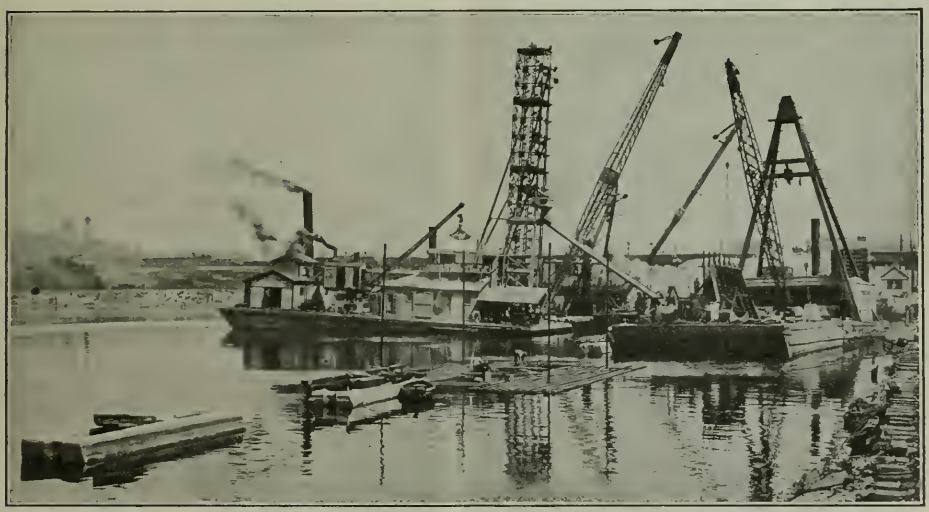
Vol. 52 April 1, 1922 NO. 13

Ohio Basin Dock Wall Construction at Buffalo

Cofferdams in water twenty-eight feet deep eliminated by use of submerged forms adjustable in gantry tower and shifted by derricks to make alternate sections of 1,460 feet of wall, 36 feet high, concreted in 25-foot lengths with bottom dump buckets filled by chutes from floating tower.

In 1920 a contract of about $435,000 was awarded to the Great Lakes Dredge & Dock Co. for the construction of 1,460 linear feet of concrete dock wall for the Ohio Basin at Buffalo, N. Y., of the New York State Barge Canal. The wall projects about 8 feet above the surface of the water where it has a thickness of 2 feet 6 inches and has a maximum height of about 36 feet and width of 18 feet, both faces being battered at the bottom and the outer face perpendicular on the upper part. It contains over 17,000 yards of concrete and had been about 60 per cent. completed when work was suspended last fall. It is expected that the work will be finished this year.

At the site the approximately horizontal surface of the bed rock is from 21 to 28 feet below the surface of the water and was covered with from 8 to 10 feet of sand, clay and earth. Under the original specifications the contractor was permitted the alternative of building the wall in the dry in a cofferdam as has been done with portions of the basin now being constructed under other contracts, or of



FLOATING DERRICKS, LIGHTERS, CONCRETE PLANT AND SUPPLY BARGES. SOUNDING RAFT IN FOREGROUND. BETWEEN TWO COMPLETED SECTIONS OF LOWER PART OF DOCK WALL.

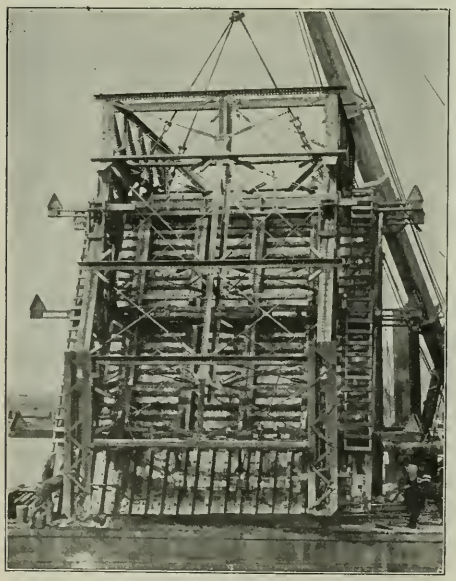
building it with concrete deposited under water up to within 12 feet of the surface of the water, above which it was to be deposited in the dry.

After the award of the contract the contractor's investigation led him to propose a new method of constructing the wall in 25-foot long sections built separately by depositing all the concrete up to water level in special submerged steel forms, which insured accuracy of alignment and dimensions and protected the fresh concrete from washing or segregation. This method was conceived and designed by F. C. Hibbard, manager of the Great Lakes Dredge & Dock Co., and W. P. Feeley, Buffalo, both experienced designers and constructors of marine and harbor improvements. This method was approved by Frank M. Williams, state engineer, whose cooperation made the execution of the work possible.

LARGE SUBMERGED ADJUSTABLE FORMS

A very important element of the equipment installed for the execution of the work was the two steel forms of unusually large dimensions, which were built by the Blaw-Knox Co. according to the contractor's general design, the details and working parts of the form being designed by the builders in accordance with their patents.

The forms for the front and rear face of the wall were 25 feet long and consisted substantially of flat steel lagging plates, countersunk riveted to the outside ribs of structural steel in transverse vertical planes 5 feet apart. The lower edges of the steel plates terminate about 5 feet above the bottom of the form and beyond this point the steel plates are replaced by wooden planks to provide for easy and accurate fitting over irregularities of the rock surface.



EXTERIOR FACE OF SUBMERGED FORM SHOWING WOODEN LAGGING AT BOTTOM.

SIDE PIECES OF FORM SUSPENDED FROM TOWER, READY FOR SUBMERSION.

The two remaining sides or ends of the form are composed of vertical transverse detachable bulkheads that have horizontal wooden lagging nailed to vertical posts that engage top, bottom and intermediate outside riveted stiffening trusses in horizontal planes. The ends of the stiffening trusses project beyond the faces of the concrete walls and engage lugs riveted to the side forms, permitting them to be securely locked together to enclose wall sections from the rock bottom to the surface of the water.

The forms, weighing about 55 tons each, are suspended by turnbuckle rods from the top of a steel gantry tower with four legs resting on the rock bottom. The tower, which is made chiefly of angles and connection plates, has two transverse bents connected by longitudinal bracing. Each bent has two legs or side members, one of them vertical adjacent to the harbor side of the wall and the other one inclined parallel to the battered face of the wall, and both of them essentially lattice girders. These girders are connected by a transverse cap or top girder 19½ feet long and 5 feet 3 inches deep, under which there is clearance for the completed wall and a form between the side pieces.

The outer members of the side pieces have telescopic vertical bottom extensions to support the weight of the tower and the suspended form from the rock bottom.

The rods suspending the form from the top of the tower are pivoted to swing transversely, giving abundant lateral displacement for the forms, which are adjusted and securely braced in position by top, bottom and intermediate connections on each side, which are pivoted to toggle joints built into the tower and operated by screw adjustments above water level. By these devices the sides of the form can be accurately set in the exact required position and rigidly maintained there while the form is in service.

UPPER PART OF TOWER WITH FORM ADJUSTABLY SUSPENDED BELOW WATER LEVEL.

after which the adjustments can be slacked off, stripping the form from the concrete and providing clearance for its removal with the tower.

The tower is supported from the rock bottom at the four corners about 27 feet apart transversely and 18½ feet apart longitudinally, the vertical adjustments of the bearings being made by bolting the telescopic pieces in different positions or by the jackscrews for small displacements, or by a combination of both methods.

EXCAVATION AND PREPARATION

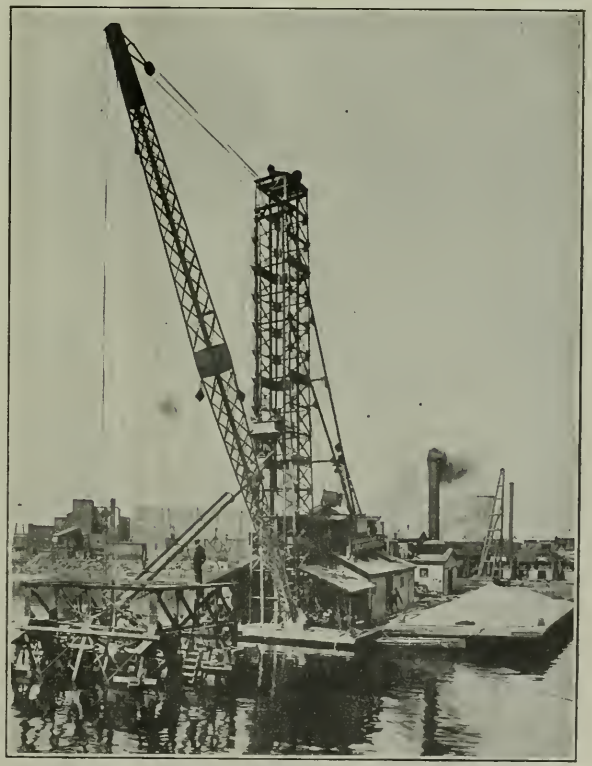
At the commencement of operations a trench about 30 feet wide and 10 feet in maximum depth was excavated in the lake bottom by a dipper dredge removing all the material that it could conveniently handle down to the surface of the rock.

The surface of the rock was then very carefully mapped and profiles constructed by means of soundings 6 inches apart on the front and back lines of the wall and across the ends of the section. The soundings were taken from a 60 x 30-foot raft having a framework of 12 x 12-inch longitudinal and intermediate cross timbers, floored with 6 x 6-inch transverse planks placed 6 inches apart in the clear, between which the soundings were taken with a wooden pole having a steel point. The raft was maintained in position by four 4-inch steel pipe spuds working in 5-inch vertical steel pipe guides, one at each corner of the raft, allowing the latter to rise and fall freely with the motion of the water. The raft was moored by four diagonal lines and was provided with a gage from which the varying elevations were recorded. Care was taken to moor the raft exactly in the required position, the soundings were corrected for the rise and fall of the water and were plotted to show the profile of the rock surface along the edges of the forms and these outlines were transferred full scale to the wooden planks forming the lower edge of the forms which were cut to fit the irregularities of the rock bottom, care being taken to cut them first for the deepest water, so that the successive positions of the form required only to have the planks trimmed a little more.

HANDLING AND ADJUSTING FORMS

The gantry tower was set up on the deck of a scow, the form suspended from it and properly connected and adjusted and the tower and form weighing together about 110,000 pounds, lifted by a pair of steel rope bridles attached to the 8-part hoisting tackle of the 75-ton floating derrick, which removed it from the scow and lowered it to position, maintaining it there until it was accurately centered and aligned and bearing on the rock bottom was effected by the adjustable vertical legs at the corners of the tower. Usually the assembling and placing of the form and gantry tower was accomplished by a gang of 20 men in 24 hours.

As soon as the form was in place a diver de-



FLOATING CONCRETE PLANT WITH HOISTING TOWER CHUTING CONCRETE FOR SUBMERGED FORM

scended in it and made a thorough examination of the rock bottom to insure the proper bearing at all points, fill any openings between the forms and the rock, and make necessary adjustments in the screw-jacks in the tower bearings. The diver also operated a hydraulic jet of 200 pounds pressure and 1½ inches nozzle diameter to loosen any earth or other material on the surface of the rock, which was immediately removed by the suction pipe of a 10-inch centrifugal pump.

CONCRETING

After the rock bottom had been inspected, satisfactorily cleaned and the form adjusted, the latter was filled with 1:2½:5 concrete made with Niagara river sand and gravel and having an extra bag of cement per cubic yard of concrete for all the underwater construction.

The concrete was mixed in a 1½-yard Lakewood machine installed on a scow that was moved up to position as soon as the form was ready. The concrete scow was served with sand and gravel delivered by supply scows alongside and handled by a clamshell bucket operated by the boom of the floating derrick and delivering into the charging hopper above the mixer. The concrete was delivered from the mixer to a bucket which was hoisted in a steel tower installed on the mixer boat. The hoisting bucket dumped into a vertically moving receiving hopper on the face of the tower from which the concrete was spouted through a steel chute to a special 2-yard bottom dump bucket that deposited it under water in the form.

The concrete was placed uniformly and continuously from the surface of the rock to the surface of the water, and was allowed to set for 48 hours before the forms were stripped and the towers and forms removed by the derrick boat. The lower edges of the forms were redressed to suit the rock profile and the forms and towers again set up for the new section of the wall 25 feet in the clear from the section last concreted. After a number of 25-foot alternate sections had been concreted the transverse bulkheads on the ends of the forms were removed and the side pieces of the forms were used to enclose the spaces between adjacent sections of the wall, which were then concreted, making the wall continuous.

When the walls are more than 20 feet high, the bottoms of the side forms are connected by temporary horizontal tie-rods 3 inches in diameter that pass through permanent sleeves imbedded in the concrete and are removed after the wall is finished. These rods are omitted in walls less than 20 feet high.

UPPER SECTIONS OF WALL

Recesses are cored in the upper surface of the wall to receive offsets in the construction joints between this part of the wall and the top portion about 8 feet high that is built in the dry in steel forms 25 feet long that weigh about 30,000 pounds each and are handled by the floating derricks. These above-water forms have steel lagging plates, countersunk riveted to exterior ribs about 5 feet apart in vertical transverse planes that are connected together above the top of the form to resist the interior pressure of wet concrete, which is also resisted by temporary horizontal ties in the bottom of the form.

The upper part of the wall, like the lower part, is made in alternate sections, the first of which are concreted in enclosed forms made with transverse bulkheads, which are then removed and the side forms used to enclose the intermediate spaces that are eventually concreted to make the walls continuous. The transverse construction joints between the successive sections of the wall, both above and below water level, are made with recesses and corresponding projections forming tongue and groove joints that bond them thoroughly together. The concrete in the upper part of the wall is proportioned 1:2½:5 and was placed at a maximum rate of 40 yards per hour. The work was so well planned and the organization so good that three 25-foot sections of the wall each containing about 275 yards of concrete were finished complete in six days.

QUALITY OF SUBMERGED CONCRETE

In order to verify the quality of the submerged concrete, manholes 2 feet in diameter were made in the first few sections of the wall that were concreted, extending from bottom to top. After the forms had been removed these manholes were pumped out and the concrete very carefully examined. This inspection showed the concrete to be of the first quality and so satisfactory that the manholes were discontinued in the later sections of the wall.

The total amount of concrete required is about 17,000 cubic yards and about 51,000 cubic yards of excavation has been made. The work has been executed with an average force of about 50 men, under the direction of R. W. Reed, superintendent for the contractor.

Road Work in 1921

Maximum mileage of state road construction—Some conclusions from the tests of the Illinois experimental road.

In a recent paper, Clifford Older, chief highway engineer of Illinois, claimed for that State that only Pennsylvania surpassed it in the mileage of high type pavements constructed last year, Pennsylvania having built 670 miles of modern high-type pavement and Illinois 412 miles; New York being next with 347 miles and Wisconsin having built 340 miles. Illinois hopes to build 1,000 miles of roads in 1922.

The director of highways of Ohio, L. C. Herrick, stated recently that Ohio leads in the nation's record of mileage of improved roads built in 1921, stating that more than 1,000 miles were constructed by Ohio, while the best previous record was 770 miles by Pennsylvania. Apparently Mr. Herrick's statement includes a considerable mileage of roads that would not come under Mr. Older's classificaiton of "modern high type." In Ohio a relatively small amount of uncompleted road building remains, and this year special attention will be given to maintenance work.

It is planned to construct something over 360 miles.

Illinois claims not only to lead all but Pennsylvania in high type construction, but takes to itself considerable credit for investigations made by means of the Bates experimental road, which was described in PUBLIC WORKS about a year ago. This road was started in 1920 and finished during the summer of 1921, and the test by running heavily loaded trucks over the road until it is tested to destruction began this week. Such research work as has been done to date has demonstrated several important facts, according to Mr. Older; among these, that the foundation soil under a pavement cannot be kept dry by means of tile drains, but that "tile drains are practically useless so far as keeping the foundation soil dry is concerned, although they may prevent excessive heaving of the slab because of frost action. The amount of water in the soil under a road slab may be as high as 40% of the weight of the dry soil, in spite of the fact that tile drains may be placed along each edge of the pavement."

Another point brought out by this test road was similar to that recently described in PUBLIC WORKS as having been determined at the Pittsburg, Cal., test road, namely, that pavement slabs curl up at the edges at night and rise off the foundation in the middle at daytime.

Mr. Older also stated that concrete slabs may be destroyed by repeated loading, owing to a fatigue of the slab. "A truck wheel carrying a load of 5 tons may pass along the edge of a 7-inch concrete pavement of the ordinary design once or twice without breaking the pavement; but if the same wheel passes along the edge from 10 to 50 times, the edge of the pavement breaks down in many places. Loads on such a pavement would have to be reduced to 2½ tons in order that trucks having wheel loads of this magnitude might be carried indefinitely by the pavement. However, investigations have shown that a pavement may carry loads equal to 60% or 70% of the critical loads only a few thousand times without breaking—in other words, in order to provide a reasonable factor of safety a pavement must not be loaded in excess of one-third of its apparent strength without danger of its failing in a comparatively short time."

Water Resources of New Jersey

Concise report on all resources available for supplying the metropolitan district comprising the northeastern quarter of the state. System needed comparable to New York's Catskill supply. Passaic Great Reservoir, Long Hill Reservoir, Raritan and other projects studied and compared.

A number of the communities in the northern part of New Jersey have in recent years endeavored to devise means or locate sources by which they might improve or enlarge their water supplies, but most of them without success. However, by state or co-operative action aimed to serve the entire Metropolitan district of that state as a unit, it seems possible to develop such abundant supplies of water that Allen Hazen, consulting engineer of New York, in a recent report is led to remark "the problem is to find a market for so much water."

In his report, a comprehensive one on the water requirements of the New Jersey Metropolitan district and the sources available for meeting them, submitted to the Board of Conservation and Development of New Jersey by Mr. Hazen, he has condensed into 70 pages possibly the most complete consideration of the water resources of northern New Jersey that has been made in recent years; and although none of the schemes proposed have been developed in their details, the relative advantages, both physical and financial, appear to have been determined with sufficient definiteness to permit the formulation of general plans of procedure for future development.

Mr. Hazen gives great credit to the New Jersey state maps showing topography, geology and forests, and the large scale maps covering a part of the area, which were used as a basis for his study of this problem. "If it had not been for these maps it would have been necessary to have made topographical surveys of the areas under consideration; our studies would have required years instead of months, and the cost of the field work, to arrive at anything like the point actually reached, might easily have exceeded the $60,000 reported as the original cost of the state survey."

Estimates of cost of this system are, of course, only approximations, since no detailed plans have been made nor even have borings been made at dam sites, along the routes of proposed tunnels, etc. However, the geology of the state has been pretty well worked out and these studies have been taken full advantage of in this investigation; while so many large dams, aqueducts and tunnels have been constructed recently in this section of the country that unit prices can be estimated with fair approximation.

The most expensive system in total cost, but the least expensive in cost per million gallons per day capacity, is estimated to have a total cost of $130,000,000 or $173,000 per m.g.d. capacity. This seems a large sum, but New York's Catskill supply had cost $150,000,000 up to December 31, 1921, and it is estimated that the development of the remainder of the Catskill supply will cost an additional $30,000,000. Moreover, this does not include filtration, as does the $130,000,000 for the New Jersey system, and if the cost of this be deducted we have the New Jersey system as costing $104,000,000 in comparison with $180,000,000 for the Catskill system. The capacities of the two are approximately the same, and the chief reason for the difference in cost is that the length of tunnels and aqueducts in the Catskill sys-

tem from the Schoharie reservoir to the Ashokan reservoir, thence to Hill View reservoir, and thence to City Hall, New York, is about 127 miles, while the corresponding length of tunnels in the New Jersey system under consideration is only 52 miles. The population to be provided for is nearly as great, being estimated at 5,600,000 in the New Jersey Metropolitan district in 1970, for which it is estimated that 820 m.g.d. will be required.

Mr. Hazen first reviews briefly the thirty-three water supply systems which now supply the 2,070,000 people living in the six counties of the Metropolitan district. Two hundred and four m.g.d. supplied to these is surface water and 40 m.g.d. is ground water. A little over 50 per cent. of the population is supplied by privately owned plants, but these supply considerably less than half the water. The per capita consumption for the privately owned plants averages 99 gallons and for the publicly owned plants 139. Of the former, 77 per cent. of the services are metered, and 66 per cent. of those of the publicly owned plants.

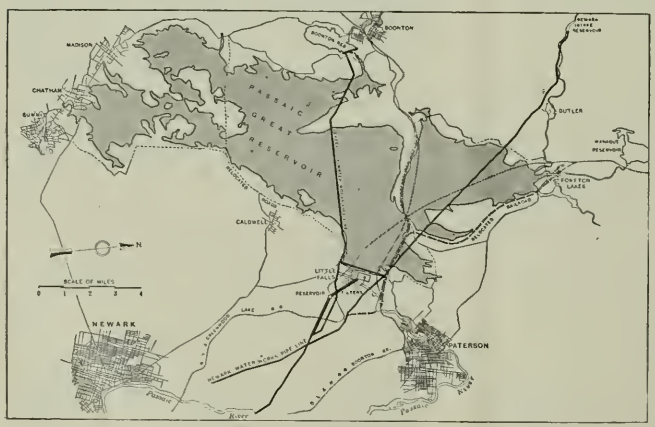
In order to show the effect of meters, Mr. Hazen has divided the systems into two classes, one in which 90 per cent. or more of the services are metered and the other in which less than 90 per cent. are metered, and finds that in the case of the former the average consumption is 89 gallons per capita and of the latter 154 gallons.

PRACTICABLE SOURCES OF SUPPLY

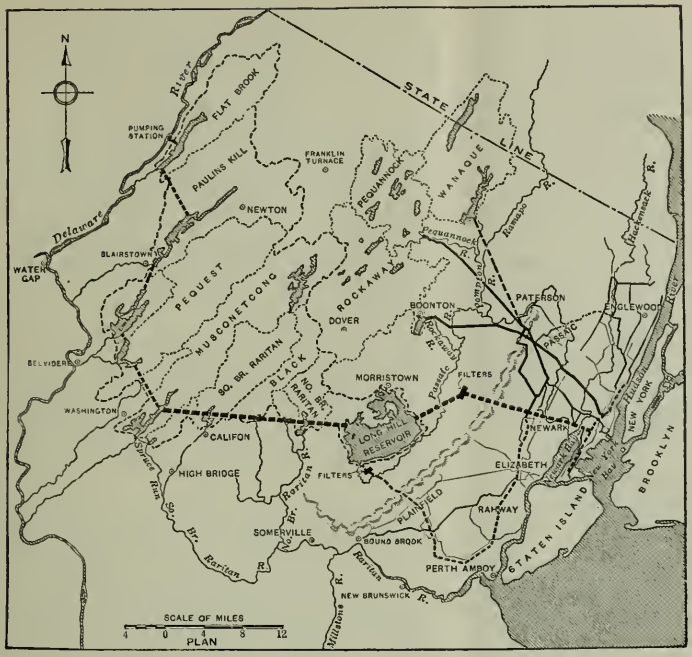
Passaic Great Reservoir:—A large part of the present supply for the district is drawn from the Passaic river and its tributaries, the largest being Newark's supply from the Pequannock, a tributary of the Passaic in the northern part of the state. One of the two sources of supply for the district which are considered most favorably by Mr. Hazen comprises the Passaic and all its tributaries above Little Falls. A dam would be built a short distance above Little Falls, which would create a reservoir called "Passaic Great Reservoir," which would extend 18 miles from north to south and would have an area of 61 square miles. One of the great advantages of this development would be that this reservoir would serve as an equalizing reservoir to prevent floods, such as the disastrous one of 1903. The chief disadvantage is the very large amount of land which must be purchased. It is not practicable to make the reservoir any smaller by constructing a lower dam, since a large part of the area to be flooded is practically level and any less height of dam would produce on thousands of acres shallower water than is considered desirable for a water works reservoir. It is estimated that the purchase of sites and payment of damages for this development would cost $39,000,000 out of the total estimated cost of $93,000,000. This reservoir would lie northwest of Newark, Jersey City and the other most thickly settled parts of the Metropolitan district, and could utilize the pipes and conduits now used for bringing supplies from this watershed, although these, of course, would have to be supplemented in the near future.

Long Hill Reservoir:—The only other supply which seems to Mr. Hazen to warrant serious consideration for potable purposes for the immediate future is that called Long Hill reservoir. As will be referred to later on, Mr. Hazen suggests the development of other supplies for manufacturing purposes solely. The Long Hill reservoir site is at the headwaters of the Passaic river west of Newark and Elizabeth and is formed naturally by a narrow ridge of trap rock eight miles long on one side, hills rising to considerable height on the other side of the valley, and a terminal moraine of ample proportion marking the northern limit of the reservoir. This moraine at its thinnest point is half a mile through at the level of the proposed water line and is a mile or more wide throughout most of its length. By building a dam on trap rock 110 feet high and 850 feet long, 24 square miles of this area would be flooded and a reservoir formed with a capacity of 328,000 million gallons, which is more than twice the size of the Ashokan reservoir and would be by far the largest water supply reservoir in the world.

The one unfortunate feature of the Long Hill reservoir is that there is little water immediately available for filling it. In order to remedy this it is proposed to tunnel under the hills lying immediately west and thus tap ten other main streams, which would furnish an abundance of water. In fact, the chain of tunnels and lakes feeding Long Hill reservoir could be extended entirely across the state to Flat Brook, which is only a mile from the Delaware River and 150 feet above it, and it would be possible to pump Delaware River water into the system either continuously or during that part of the year when the flow of the river is ample. The capacity of the storage reservoir would be such that practically the entire run-off of all the watersheds



PASSAIC GREAT RESERVOIR.

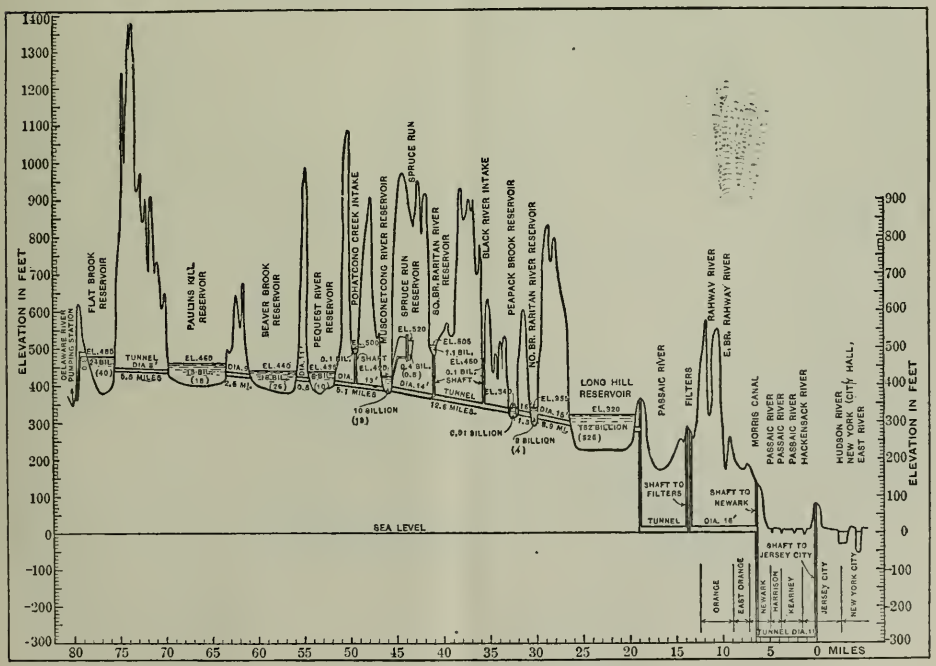


PLAN OF LONG HILL SYSTEM.

could be utilized. These sheds would be those of the northern branch of the Raritan, south branch of the Raritan, Musconetcong, Pequest, Beaver Brook, Paulinskill and Flat Brook. These would give a total catchment area of 645 square miles tributary to Long Hill reservoir.

The Long Hill reservoir would flood land on which are now found 781 dwelling houses, several grist mills, greenhouses, etc. About 40,000 people live on the entire catchment area, which population has not increased during the past 20 years. A small part of Morristown naturally drains toward the reservoir, but that city is already completely sewered, and the sewage is pumped to disposal works outside the catchment area.

The Long Hill reservoir would receive an ex-



PROFILE OF LONG HILL SYSTEM.

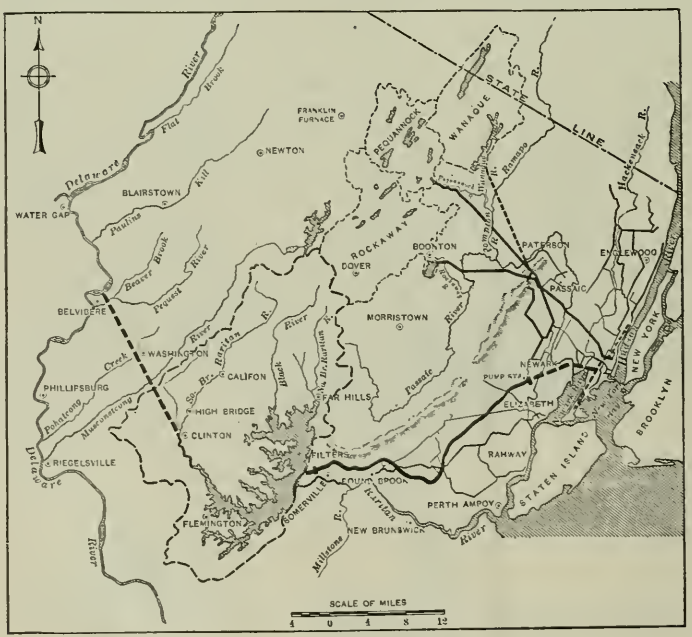
cellent character of water, although the precaution should be taken of filtering it and treating it with chlorine or other disinfectant, and the elevation, 320 feet above sea level, is such that the greater part of the area could be served by gravity. Moreover, it would require a tunnel only 19 miles long to bring the water to Newark and Jersey City and thus connect with the mains throughout the entire district.

Other Sources:—Two other sites were considered at some length, one of these a reservoir on the Raritan river a little west of the center of the state, the other an impounding of the Mullica and Wading rivers, about three-quarters of the way down the state, or southeast of Camden. The last named is too distant to consider unless other sources were unavailable, and in addition should probably be reserved for the needs of the southern part of the state. The Raritan project would cost a little more than the Passaic Great Reservoir, with less capacity, and would require considerably more pumping and longer aqueducts.

(To be continued)

$3,000,000 Memorial Bridge

Bill No. 10,243, now before the House of Representatives, calls for the Federal appropriation of $1,500,000 towards the construction of a $3,000,000 bridge to carry the Lincoln Highway across the Susquehanna river in Lancaster county, Pennsylvania, connecting the boroughs of Columbia and Wrightsville and serving as a memorial to Abraham Lincoln and to General John F. Reynolds, who lost his life in the Civil War repelling the invasion which reached its northernmost point at the site of the bridge. The bill also calls for the provision of $25,000 to secure a design and begin the construction of the bridge, which shall be used exclusively for foot passengers and vehicles.



RARITAN SYSTEM.

Imhoff Tank Troubles

In connection with the articles on Imhoff tanks, recently published in PUBLIC WORKS, we have asked several engineers to comment on Mr. Riker's discussions of the subject, and among these is George T. Hammond, who has for a number of years been in charge of the sewage experimental plant of Brooklyn, N. Y., practices as consulting engineer on sewerage work, and is one of the leading engineers of the country on this subject.

Mr. Hammond writes us that he would prefer not to enter into any long discussion of this paper, feeling that he has sufficiently stated his opinion relative to tanks for treating sewage in his paper contributed to the symposium on "Stream Pollution and Sewage Disposal" before the American Society of Civil Engineers. He, however, makes the following comments:

Mr. Riker's paper has interested me greatly, but it is more concerned with presenting adverse data and stating difficulties encountered in New Jersey tank operation than it is with constructive criticism. If he is correct we shall all have to take to fine screens, I fear. He has certainly gathered and presented many disconcerting data for a tank man to explain. I am not sure, myself, that his conclusions are not correct, as they appear justified by his personal experience and observation, and I regard him very highly as an expert observer.

But I am unwilling to admit that his opinion is conclusive. I have seen many tanks operate without any trouble—and have operated some myself. Also I have seen many that gave trouble—and have had troubles myself with some. My own observations, however, tend at least to sustain the opinion that most of the troubles encountered are caused by poor design, or design not properly answering the local conditions, often because local conditions have not been correctly studied or interpreted—inadequate size, bad hydraulic and other faulty applications of principles—or rather failure to provide for the hydraulic requirements called for, etc., and finally, crass neglect after the tank is installed—or at best improper operation.

I do not believe that sanitary engineers are going to abandon the use of tanks in sewage treatment—tanks offer too many advantages. Mr. Riker has done us all a favor in pointing out many difficulties—all of which, I hope, will be overcome in time by constructive study. I hope he will now turn his attention toward solving some of these problems.

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Highway Drains

Elsewhere in this issue, in an article giving abstracts from a paper by Clifford Older, chief highway engineer of Illinois, he is reported to have stated that the foundation soil under a pavement cannot be kept dry by means of tile drains, such drains being practically useless for this purpose. This apparently is given as a general statement, although based upon experiments made at the Bates experimental road by the Illinois highway department.

It is possible that Mr. Older did not intend this to be taken as a statement of general application, and it certainly should not be. In the heavy prairie soil on which the Bates road is laid, where there seems to be no possibility of draining the subsoil except by long ditches to distant depressions or streams, it is quite probable that tile drains under a pavement would have very little effect in drying out the ground. As a general statement, however, we think there is abundant proof in other localities that tile drains are of considerable use in keeping a subsoil dry where there is a point near at hand at which the water can rapidly flow away from the end of the drains. In other words, where the wetness of the subsoil is more or less localized and is not universal throughout the section through which the road passes, drains could be expected to do some good in the removal of subsoil water, the amount of benefit which they confer depending of course upon the wisdom with which the drainage system is designed and the natural possibilities of ground slope, drainage channels, etc.

It seemed to us desirable to make an explanation of this kind lest some young highway engineers might consider, from Mr. Older's statement, that it is no longer considered desirable to use drains under highway pavements.

Submerged Concrete Forms

Occasionally the application of a new method or process or the modification of old ones opens an important new field in construction. This is perhaps now the case in building submerged concrete walls and other substructures that are often very difficult and costly when executed by methods generally used heretofore.

Dock walls, piers, retaining walls, canal locks, foundations and other submerged substructures have generally been built in open or pneumatic caissons which are costly and slow; or with precast units that, when of large dimensions, require heavy plants for their transportation and handling and may involve difficulties and uncertainties in their foundations; or they are built in the dry in cofferdams which are likely to be very expensive to construct, maintain and unwater; or for very simple mass work the concrete has been deposited in submerged cribs, caissons, pits or trenches by the tremie method or by bottom-dump buckets, usually without complete protection or accurate dimensioning, and generally with some distrust of the quality and precision of the concrete.

These methods have been eliminated and many of the objections and difficulties are removed or overcome by the method worked out as described in this issue, and successfully applied to the construction of a long, wide, and high continuous concrete wall in deep water with moveable steel forms in which alternate sections of a perfect and accurate wall were successfully concreted and subsequently joined together to form one continuous structure by the use of the same forms for concreting the intermediate spaces.

This method secures a satisfactory foundation on solid rock by ordinary dredging methods; permits, examination of the surface and the adjustment of the form with a minimum of diver's work; and provides for the construction of massive 1,600-ton units in place, and their connection to form a single continuous wall of exact dimensions and assured quality at a cost probably considerably less than by the cofferdam, caisson or precast method.

The methods, with slight modifications, are apparently practicable for almost any ordinary conditions under which harbor work can be constructed, for a very wide range in the dimension of the structure and in the depth of the water. It requires only ordinary heavy floating equipment and the special forms; it eliminates a large amount of costly plant and labor required by other methods; and makes provision for satisfactory foundations, good bearing and the inspection of the bottom. By this method substructures may be built in very deep water or in shallow water; balanced pressures are maintained; continuous concreting secured, and expensive pumping and bracing avoided.

The special feature of the work is the idea of an adjustable, detachable steel form of large dimension and great rigidity suspended from a moveable tower astride of it that is seated on the bottom and provides for the adjustment, alignment and stripping of the form, which, with the tower, is moved as a unit from section to section as the structure is advanced.

The forms were designed and detailed by experienced contractors and form builders, and embody some of the principles that have been so successfully developed within the last few years for the construction and operation of forms for large tunnel construction.

Sewage Treatment in Imhoff Tanks

By Paul Hansen *

I have read with very great interest the series of articles by Mr. Russell Riker on "Sewage Treatment in Imhoff Tanks" and feel that we are indebted to him for some very instructive and valuable comparative data on Imhoff tank design and operation. I do not feel, however, that he has succeeded in "making a case" against the Imhoff tank as he apparently sets out to do. Rather he has called our attention to imperfections in design and operation and the existence of some uncertain factors in this connection that require further study and investigation.

He has not pointed out very satisfactorily any suitable alternative for the Imhoff tank except for rather vague references to septic tanks operated in rotation and sedimentation tanks with separate sludge digestion chambers. All of the methods which Mr. Riker mentions as means for overcoming the recognized evils of septic tanks were fully tried at Columbus, both in the preliminary experiments in 1904 and later in the full size plant. Primary and secondary tanks were provided and in the secondary tanks were placed hanging and submerged baffles all for the purpose of trapping the sludge thrown into suspension through ebullition. By the use of multiple tanks it was also presumed that when ebullition began in any tank, that tank could be shut off until sludge could be removed or until ebullition ceased. All of this, however, proved of little avail and much trouble resulted from clogging of sprinkler nozzles on the sprinkling filters and from bad odors, due to the staleness of the sewage as it reached the sprinkling filters.

Separate sludge digestion also proposed as a substitute for Imhoff tanks likewise has its difficulties, the principal one being that of promptly removing settled sludge to the sludge digestion chamber. A promising effort along this line is the combination of sedimentation tanks with Dorr plows and a separate sludge digestion tank or pit. I understand that the Dorr Company is conducting some experiments with this device at the present time at Rochester. It would seem that there should be no difficulty in obtaining results, but there is as yet the question as to whether the results can be reached with reasonable economy.

These comments on Mr. Riker's articles are not intended to argue the adequacy of the Imhoff tank but merely to indicate that it is probably the best mode of sewage sedimentation thus far devised. It may be superseded by better methods but it is also true that a better understanding of the design and operation will probably lead to better results and to better control over results. A lengthy paper might be written on the various imperfectly understood elements in Imhoff design and operation.

In 1911 I was one of the first to point out, in response to articles written by Mr. Hering, that we must guard against being hypnotized by the Imhoff tank as we were by the septic tank and that we should not hail this new tank as the solution of all of our sewage sedimentation troubles, but recognizing its obvious merits and demerits, it should be used cautiously and carefully. Everyone was inclined to admit at the start that the success of Imhoff tanks could only be predicated on correct and intelligent operation.

I see no reason to change from the above attitude, but I do believe we should not condemn the Imhoff tank until something assuredly better is before us and until we have fully exploited the still unknown or uncertain factors.

*Of Pearse, Greeley & Hansen, Consulting Engineers.

Another Discussion of Imhoff Tanks

The following discussion of the article on Imhoff tanks by Russell Riker has been contributed by M. B. Tark, engineer of the Link Belt Company of Philadelphia. Mr. Tark informs us that this is largely taken from the report of the Institute for Water Hygiene referred to, supplemented by views of Prof. Dr. Thumm, Dr. Kusch and Dr. Steuer, obtained by correspondence.

Mr. Riker's article will be carefully studied by every designing engineer and operator of sewage treatment plants and the result will be a number of better designed and better operated plants. A comparison of his investigations with those made by the Institute of Water Hygiene, Berlin-Dahlen, shows that the experience with Imhoff Tanks in Germany has been very much the same as in New Jersey. If anything it has been worse, principally because it has been longer.

Fortunately or unfortunately, the first tanks built by the Emscher Sanitary District gave excellent results, due to the composition of the local sewage. But as soon as tanks were constructed in other parts of the country, complaints began to come in. Conditions became so bad in many plants, that after a year of investigation the Institute built an experimental tank, in which an agitator in the digesting chamber was installed. Practically all troubles—acid, undigested sludge, scum and foaming, were due to the digesting chamber; careful operation was the remedy.

Maintenance of an alkaline reaction in all parts of the digesting chamber was found absolutely essential to the proper putrefactive decomposition of the sludge. Samples must be taken not only of the sewage and sludge, but also of the supernatant water in the digesting chamber. This is regarded as the factor of safety in the operation of the plant and *the proportion of 2 parts of sludge to 1 part of supernatant water* must be strictly adhered to. Only in old ripe tanks or in those handling septic sewage can this proportion be changed. Septic sew-

age is strongly alkaline, has lost its gas-forming ability and therefore will very seldom cause trouble. The fresh sludge should be thoroughly mixed with the supernatant water, but it is not desirable to mix the digested with the fresh sludge, as it is quite possible for digested sludge to become acid again. The mixing of the incoming sludge with supernatant water was accomplished by running the agitator for a short time every day. In some of the older plants the mixing was done successfully by blowing air through the pressure pipe, in others water was tried, giving good results in some cases and making conditions much worse in others.

Scum and foaming are most serious during the period of ripening. Scum is settled sludge and its floating ability is due to its contents of the gases of decomposition. Large particles, especially feces, retain their floating ability longer than smaller ones, they should therefore be kept out of the tank by screens. Breaking up and sinking the scum by a hose or paddling is less effective than the use of an agitator. If a hose is used, sewage is preferable to water. Foaming in an unripe digesting chamber is only a secondary phenomenon, it is caused by large amounts of gas rising to a small surface and carrying the sewage and finely divided sludge with it in the form of bubbles. The gas vents should be not less than 25 per cent of the total area of the tank.

In ripe tanks the scum formation will not be nearly so heavy or so offensive, but the scum will have to be removed from time to time.

On the principle that prevention is better than cure, the Institute cautioned municipalities not to pay for the tanks until the digesting chamber is ripe and the whole plant in good working order. It also recommends the installation of sedimentation tanks with separate sludge digesting chambers. A number of these tanks of various types have been built and given good results.

Many of our leading engineers now prefer fine screens to tank, especially where the effluent is treated on sprinkling filters or where the composition of the sewage makes the successful operation of a digesting tank doubtful or improbable.

State Licensing of Engineers*

RECIPROCITY BETWEEN STATES

All of the states grant reciprocity in the matter of licenses to the extent of not requiring an examination of applicants, but all require the payment of the same fee as is required of resident engineers. However, engineers who serve as consulting associates of an engineer registered under the provisions of the Act are not required to be licensed in Louisiana, North Carolina, Tennessee, Minnesota and West Virginia, but must prove their competency to serve in such capacity.

Certain of the states permit engineers residing in other states to practice for a limited number of days without requiring a license. North Carolina permits this up to 30 days in each year; Arizona 30 days; Colorado 90 days; Tennessee 15 days; New Jersey 30 days; Minnesota 30 days; New York 30 days; Oregon 30 days; Pennsylvania 30 days; West Virginia 30 days. In each of these cases, it is specified that this privilege is granted only to those who are legally qualified for such professional services in their own state. In Oregon it is required that an engineer, to obtain such exemption, must "first give notice in writing to the board of engineering examiners of his intention to practice in Oregon."

*Concluded from page 209.

AMOUNT OF LICENSE FEE

The fees required by the various states are as follows: $25 in Florida, Iowa, Louisiana, North Carolina, Indiana, Tennessee, New Jersey, Minnesota and New York; $20 in Michigan, Virginia, Pennsylvania and West Virginia; $15 in Arizona, Colorado and Oregon. These are for license for engineers. The same fees are required for license for surveyors except in North Carolina and Arizona, where surveyors' license is $10.

In New Jersey and New York, the license is $25 for either engineering or surveying or $35 for both. In Pennsylvania license is $20 for either or $30 for both. The license must be renewed each year, renewals costing $5 in Florida, Michigan, North Carolina, Arizona, Colorado, Tennessee and Minnesota. Renewals cost $1 for surveying and $3 for engineering in Louisiana; $10 in Indiana and West Virginia; $1 in New Jersey, New York and Pennsylvania and $3 in Oregon.

In addition to the license fee, it is required in New Jersey that the license be recorded and the fee for recording be paid. A number of the states require that a seal be purchased and used on certain specified classes of maps and documents.

REQUIREMENTS FOR LICENSE

Requirements for receiving a certificate are quite similar in all the states, although several have minor peculiarities of their own. Practically all require that the applicant be of good moral character. He must be at least 21 years of age in Florida, Michigan, Louisiana, Virginia, North Carolina, New Jersey, New York and Oregon, and 25 years in Iowa, Arizona, Indiana, Colorado, Minnesota and Pennsylcania.

In Florida he must have had 6 years' practice in engineering and at least 1 year in charge of work, or be a graduate of an engineering school with 4 years of practice, one of them in charge of work. In Iowa, he must have 6 years' practice, one in charge, but each year successfully passed in an approved engineering school is accepted for one year of practice. Michigan requires 6 years' practice, or graduation plus 2 years. In Louisiana the recipient of a license must be a graduate of an engineering school or must pass a satisfactory examination in surveying, plane trigonometry and the use of instruments, with the addition of natural philosophy for an engineering license. In Virginia he must pass an examination, satisfying the board as to his practical experience and general ability and have had at least 4 years or practical experience under a certified professional engineer, or be a graduate of an engineering school.

North Carolina requires 5 years of practice or in teaching or studying engineering, time spent by an

engineering student in the army, navy or marines during the World War being considered as an equivalent time of experience; or he may be a graduate of an approved engineering school. Or, he may be a full member of the American Society of Civil Engineers, American Institute of Chemical Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Naval Architects and Marine Engineers, "or such other national or state engineering or architectural societies as may be approved by the board, the requirements for full membership of which are not lower than the requirements for full membership in the professional societies or institutes named above." Membership in same societies is also accepted in Arizona, Tennessee and West Virginia. Arizona required 3 years of practice, teaching or study of engineering, or society membership. Indiana requires 10 years of practice, or graduation as engineer and 4 years' practice. Colorado requires 7 years' practice, teaching or study. Tennessee requires 10 years' practice, or graduation and 4 years' practice, or society membership. New Jersey requires 6 years' practice, one in charge of work, or graduation and 4 years' practice. Minnesota requires 6 years' practice, teaching or study. New York requires 6 years' practice, one in charge of work, or graduation and 4 years' practice. Oregon requires 6 years, one in charge of work, or graduation and 2 years. Pennsylvania requires 10 years' practice, or graduation and 4 years. West Virginia requires 10 years' practice or graduation and 4 years, or society membership.

In the above, it will be noticed that graduation from an engineering school has been given increasing weight during the later years. Florida in 1917, accepted graduation from an engineering school as equivalent to 2 years of practice. Michigan and Iowa in 1919, accepted graduation as equivalent to 4 years' practice, as did Virginia in 1920. In 1921, North Carolina accepted graduation as equivalent to 5 years' practice and Colorado, Tennessee, Pennsylvania and West Virginia accepted graduation after a 4 years' course as equivalent to 6 years of practice. In the same year, however, New Jersey and New York accepted graduation as equivalent to only 2 years of practice and Oregon as equivalent to 4 years.

Practically all of the states require that an engineer, to receive a license, must be a citizen of the United States or of Canada and speak and write the English language. Several of the states grant licenses to those who have declared their intention to become citizens of the United States. Pennsylvania permits licenses to citizens of foreign countries who have practiced engineering for a period of more than 10 years, upon presentation of satisfactory evidence that he is qualified to practice and at the discretion of the board. New Jersey gives special emphasis to the fact that, in determining the qualification of applicants, "character shall be given predominant weight."

The above are the principal features as they affect engineers. A considerable part of each of the state laws deals with the board of registration, detailing how it shall be constituted, the duties of the secretary and treasurer, etc. The laws include a statement of the penalties for acting or attempting to act as engineer without securing a license, for misrepresentation in securing a license, etc. Provision is made in each Act also for a revocation of license by the board, generally providing that any person may prefer charges of fraud, incompetency or other acts or characteristics making it undesirable that the engineer retain his license and providing for hearings before the board and, in some cases, appeals from the board to the courts. The penalty in most cases is $100 or more or imprisonment for from 3 months to several years.

ADDRESSES OF STATE BOARDS

The details of application of the laws will lie to a considerable extent with the boards and be set forth in the rules and regulations adopted by them and which can be obtained on application. In the absence of more definite information, applications addressed to the state board of registration at the capital of the State would probably reach the proper parties. The list below, however, gives the officials now (or recently) in office, who may be addressed for further information:

Arizona—State Board of Registration for Architects, Engineers, Land Surveyors and Assayers. Secretary, L. B. Hitchcock, Room 7, City Hall, Phoenix.

Colorado—State Board of Engineer Examiners. Secretary, Addison J. McCune, state engineer, Capitol Building, Denver.

Florida—State Board of Engineering Examiners, 215 E. Bay Street, Jacksonville. Secretary-treasurer, A. D. Stevens, Jacksonville.

Indiana—State Board of Registration for Professional Engineers and Land Surveyors. Secretary, DeWitt Moore, State Capitol, Indianapolis.

Iowa—State Board of Engineering Examiners. Secretary, Earl C. Kastberg, Box 923, Des Moines, Ia.

Louisiana—State Board of Engineering Examiners, 815-17 Maison Blanche Bldg., Annex, New Orleans. Secretary, Donald Derickson, New Orleans.

Michigan—State Board for the Examination and Registration of Architects, Engineers and Surveyors. Secretary, C. T. Olmstead, 80 Griswold Street, Detroit.

Minnesota—State Board of Registration for Architects, Professional Engineers and Land Surveyors. Secretary-treasurer, R. T. Downs, 804 Phoenix Bldg., Minneapolis.

New Jersey—State Board of Professional Engineers and Land Surveyors. Trenton.

New York—State Board of Licensing for Professional Engineers and Land Surveyors. Secretary, H. G. Reist, General Electrical Company, Schenectady.

North Carolina—State Board of Registration for Engineers and Land Surveyors. Secretary, Harry Tucker, 1301 Hillsboro Road, West Raleigh.

Oregon—State Board of Engineering Examiners, 520 Corbett Bldg., Portland. Secretary, A. B. Carter.

Pennsylvania—State Board for Registration of Professional Engineers and Land Surveyors, State Capitol, Harrisburg. Chairman, Richard L. Humphreys, 805 Harrison Bldg., Philadelphia.

Tennessee—State Board of Architecture and Engineering Examiners. Secretary, Henry C. Hibbs, 4th and 1st Bank Bldg., Nashville.

Virginia—State Board of Examination and Certification of Architects, Professional Engineers and Land Surveyors. Secretary, C. G. Massie, Amherst.

West Virginia—State Board of Registration for Engineers. Secretary, Geo. E. Taylor, 504 Coyle & Richardson Bldg., Charleston.

Table No. 1—City Paving Done in 1921

Supplementary data to those published in the issue of February 18th, giving all returns received since the data first received were compiled. Continued from last week.

II—Warrenite-Bitulithic and Concrete

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
Illinois:				
Alton	....	.....	1,405	.....
Ashton	....	.....	24,897	.....
Barrington	....	.....	16,371	.....
Belleville	....	.....	9,866	4.02
Belvidere	....	.....	1,056	.....
Berwyn	....	.....	32,365	.....
Carlinville	....	.....	5,880	.....
Chicago	....	.....	230,715	.....
Durand	....	.....	6,820	.....
E. St. Louis	....	.....	9,720	.....
Effingham	....	.....	13,612	.....
Elgin	....	.....	18,079	.....
Freeport	....	.....	9,744	39,553.00
Glencoe	....	.....	12,050	4.59
Harvey	....	.....	14,877	.....
Johnson City	....	.....	10,992	4.76
Kankakee	....	.....	1,185	.....
La Salle	....	.....	11,925	.....
Martinsville	....	.....	4,101	.....
Morris	....	.....	3,295	.....
North Chicago	....	.....	27,200	.....
Oak Park	....	.....	15,067	51,368.00
Paris	....	.....	7,600	.....
Plainfield	....	.....	23,994	3.53
Robinson	....	.....	12,614	1.95-4.45
Rockford	....	.....	9,160	2.55
South Beloit	....	.....	60	.....
Urbana	....	.....	30,200	4.52
W. Frankfort	....	.....	13,069	4.21
W. Hammond	....	.....	13,568	.....
Winnetka	....	.....	3,501	.....
Wood River	....	.....	30,130	.....
Indiana:				
Anderson	....	.....	6,461	3.15
Avilla	....	.....	3,299	3.44
Columbia City	....	.....	3,260	.....
Connersville	....	.....	5,470	.....
East Chicago	....	.....	14,430	.....
Fremont	....	.....	15,972	.....
Greencastle	....	.....	7,986	.....
Indianapolis	....	.....	69,168	3.70-3.76
Kokomo	....	.....	8,636	.....
Logansport	....	.....	50,000	.....
Louisvile	....	.....	12,255	.....
Marshalltown	....	.....	6,800	3.37-3.58
Michigan City	....	.....	2,500	.....
Middletown	....	.....	13,741	2.67
Muncie	....	.....	5,658	3.69
Newcastle	....	.....	36,000	2.60
Richmond	....	.....	20,215	2.25-3.26
Terre Haute	....	.....	17,758	.....
Winchester	....	.....	1,000	.....
Wolcottville	....	.....	7,322	.....
Iowa:				
Burlington	....	.....	35,037	1.79-3.35
Cedar Rapids	....	.....	12,276	4.18
Charles City	....	.....	4,400	3.48
Council Bluffs	....	.....	1,300	3.95
Davenport	....	.....	28,278	2.05-2.48
Denison	....	.....	100,000	500,000.00
De Witt	....	.....	26,950	3.19-3.69
Dubuque	6,818	.....	....	.....
Eldora	....	.....	13,575	2.97
Kenwood	....	.....	3,155	.....
Le Mars	....	.....	330	852.00
Mason City	....	.....	2,900	3.40
Missouri Valley	....	.....	78,262	2.30-2.99
Mt. Pleasant	....	.....	1,700	3.45-3.50
Orange City	39,303	.....	....	.....
Paullina	....	.....	2,000	3.58
Parkersburg	26,686	.....	....	.....
Rudd	....	.....	3,900	4.96
Sheldon	....	.....	61,244	3.18-3.35
Sibley	....	.....	77,100	3.47
Sioux City	....	.....	132,770	2.79-3.99
Spirit Lake	....	.....	15,147	3.35
Waukon	....	.....	4,000	3.93
Kansas:				
Bonner Springs	....	.....	4,378	2.30
Effingham	....	.....	2,483	3.35
Hutchinson	....	.....	7,000	2.44-2.48
Iola	....	.....	12,107	2.45
Kansas City	15,114	.....	92,185	2.05-2.68
Lawrence	....	.....	7,300	2.85
Leavenworth	....	.....	24,899	2.36-2.50
Kansas—Continued				
Manhattan	....	.....	1,120	2.90
Minneapolis	....	.....	26,925	3.26
Osawatomie	....	.....	6,500	2.43
Pittsburg	....	.....	2,007	3.06
Wellington	....	.....	4,300	3.00
Kentucky:				
Beattyville	....	.....	7,740	3.06
Central City	....	.....	522	.....
Corbin	....	.....	3,753	3.00
Cote Brilliant	....	.....	600	2.65
Dayton	....	.....	1,580	2.30
Jackson	....	.....	1,331	.....
Lexington	....	.....	12,030	2.89-3.34
Louisville	....	.....	22,597	1.49-1.53
Mt. Sterling	....	.....	11,155	.....
Newport	....	.....	10,258	2.03-2.32
Paducah	....	.....	40,000	2.21
Pineville	....	.....	786	.....
Prestonburg	....	.....	20,000	.....
Williamstown	....	.....	16,068	.....
Louisiana:				
Baton Rouge	....	.....	920	.....
New Iberia	....	.....	16,000	2.76
New Orleans	66,457	368,083.00	....	.....
Shreveport	....	.....	3,110	.....
Maine:				
Bangor	....	.....	11,000	.....
Bath	....	.....	4,200	.....
Brunswick	....	.....	4,500	.....
Fairfield	....	.....	866	.....
Foxcroft	....	.....	555	.....
Saco	....	.....	1,832	3.56
Maryland:				
Baltimore	....	.....	16,560	2.06
Cumberland	....	.....	8,440	3.47-4.50
Massachusetts:				
Boston	10,674	3.09	....	.....
Brookline	3,335	7,337.00	....	.....
Chicopee	....	.....	2,980	.....
Chelsea	46,547	.....	....	.....
Chicopee Falls	....	.....	400	.....
Everett	....	.....	12,029	.....
Fairview	....	.....	3,000	.....
Fall River	75,818	.....	....	.....
Framingham	....	.....	2,500	2.50
Gardner	....	.....	35,000	.....
Gilbertville	....	.....	2,040	.....
Great Barrington	....	.....	11,800	.....
Greenfield	....	.....	8,700	58,000.00
Hadley Falls	....	.....	710	.....
Haverhill	18,021	.....	....	.....
Housatonic	....	.....	6,743	.....
Leominster	....	.....	1,556	.....
Malden	....	.....	1,174	.....
New Bedford	139,566	395,500.00	....	.....
North Adams	....	.....	1,836	2.62
Northampton	....	.....	1,230	.....
North Dighton	....	.....	14,653	.....
Revere	....	.....	2,000	2.00
Shrewsbury	....	.....	2,134	.....
Southbridge	....	.....	3,945	.....
Taunton	....	.....	5,060	3.49
Uxbridge	....	.....	12,512	.....
Ware	....	.....	10,160	.....
Watertown	....	.....	18,316	3.40
Wellesley	1,570	.....	....	.....
Williamsett	....	.....	4,030	.....
Worcester	....	.....	5,557	22,623.00
Michigan:				
Allegan	....	.....	11,218	1.60-2.70
Belding	....	.....	4,100	.....
Dearborn	....	.....	9,300	3,102.00
Ecorse	....	.....	10,000	2.95-3.00
Hartford	....	.....	3,350	2.65
Hind	....	.....	16,000	2.64
Lansing	....	.....	5,000	.....
Menominee	....	.....	27,128	.....
Monroe	....	.....	36,800	.....
Mt. Pleasant	....	.....	5,000	.....
Muskegon	....	.....	64,553	.....
Otsego	....	.....	15,000	2.48
Port Huron	....	.....	41,771	164,792.00
River Rouge	....	.....	38,660	2.65-3.00
Royal Oak	....	.....	9,312	2.40
Standish	....	.....	10,266	.....
Sturgis	....	.....	18,156	2.30
Three Rivers	....	.....	11,374	2.30
Union City	....	.....	5,581	2.58

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
Minnesota:				
Brainerd	....	.....	13,650	2.70-2.93
Breckenridge	....	.....	49,233	.....
Eveleth	....	2,973,00	....	.....
Farmington	29,861	.....	....	.....
Hastings	17,994	.....	....	.....
International Falls	....	.....	18,250	3.08-3.58
Luverne	....	.....	160,000	510,000.00
Mankato	....	.....	5,850	2.20-2.34
Minneapolis	....	.....	29,159	.....
Northfield	....	.....	25,000	2.91
Slayton	....	.....	14,563	2.68
St. James	....	.....	18,700	2.73-3.10
Thief River Falls	42,435	.....	....	.....
Virginia	....	.....	47,957	134,098.00
Wardena	....	.....	16,391	2.54
Mississippi:				
Jackson	....	.....	47,006	1.70-1.89
Vicksburg	....	.....	2,500	7,000.00
Missouri:				
Albany	....	.....	3,000	.....
Booneville	....	.....	11,187	1.65-1.71
Cape Girardeau	....	.....	23,500	54,000.00
Cherokee	....	.....	45,470	2.05
Clinton	....	.....	1,350	.....
Columbia	....	.....	2,240	2.25
Fayette	....	.....	2,412	2.20
Illmo	....	.....	2,070	2.68
Maplewood	....	.....	22,128	1.90-2.60
Mt. Grove	....	.....	5,800	.....
No. Kansas City	....	.....	7,500	2.50
St. Joseph	....	.....	19,502	2.40-3.75
University City	....	.....	2,510	2.45
Montana:				
Billings	....	.....	6,604	28,654.00
Bozeman	2,717	.....	....	.....
Deer Lodge	....	.....	17,137	3.10
Great Falls	....	.....	18,957	2.62½
Kalispell	....	.....	6,800	3.26
Lewiston	....	.....	12,728	2.98½
Roundup	6,075	.....	....	.....
Nebraska:				
Broken Bow	....	.....	7,023	.....
Butler	....	.....	1,944	2.88
Chadron	58,519	.....	....	.....
Nelson	....	.....	16,908	2.23
North Platte	....	.....	1,500	3.20
Pawnee	....	.....	31,403	2.24
Plattsmouth	....	.....	13,812	2.65
New Hampshire:				
Keene	....	.....	9,958	2.58
Lebanon	....	.....	630	.....
Manchester	....	.....	750	.....
Nashua	....	.....	15,781	2.50
New Jersey:				
Allenhurst	7,088	.....	....	.....
Altoona	....	.....	2,527	3.40-4.05
Asbury Park	23,351	.....	....	.....
Bordentown	....	.....	1,200	2.95
Belleville	6,287	.....	3,650	2.60
Beverly	....	.....	7,456	.....
Belvidere	....	.....	13,700	3.25
Bridgetown	....	.....	455	2.32
Butler	....	.....	2,666	.....
Cranford	....	.....	7,100	2.80
Dover	1,115	.....	....	.....
Elizabeth	....	.....	24,172	2.73-2.95
Hasbrouck Hgts.	....	.....	2,627	4.00
Hohokus	....	.....	675	.....
Kearney	36,372	.....	20,600	2.85-2.98
Little Ferry	....	.....	7,597	3.20
Metuchen	....	.....	12,000	2.90
Ocean	5,784	.....	....	.....
Orange	8,029	.....	590	3.00
Pennsville	....	.....	4,434	2.55
Perth Amboy	18,581	.....	....	.....
Ramsey	....	.....	11,035	3.39
Red Bank	....	.....	6,545	2.79
Ridgefield Park	....	.....	12,300	2.45
Roselle Park	....	.....	37,000	210,650.00
Somerville	....	.....	15,124	.....
South Orange	....	.....	4,200	2.75
South River	6,000	.....	....	.....
Spring Lake	....	.....	14,000	.....
Trenton	....	.....	12,909	2.37-2.98
Union	....	.....	7,800	.....
Washington	....	.....	7,117	.....
Westfield	....	.....	16,500	65,000.00
West Orange	2,030	.....	....	.....
Woodbridge	7,294	.....	....	.....
New Mexico:				
Albuquerque	6,336	.....	....	.....
Carlsbad	....	.....	29,308	.....
Clovis	42,000	4.45	....	.....
Las Cruces	....	.....	12,046	2.53
Las Vegas	42,946	.....	....	.....
Raton	21,903	.....	22,134	3.12
New York:				
Afton	....	.....	7,044	4.26
Albian	....	.....	13,700	.....
Alden	....	.....	980	.....
Amenia	....	.....	2,400	.....
Amityville	....	.....	20,264	2.69-2.96
Amsterdam	....	.....	9,183	3.22
Attica	....	.....	17,280	3.00
Auburn	....	.....	4,274	2.80
Avoca	....	.....	6,611	.....
Bath	....	.....	2,700	.....
Babylon	....	.....	5,800	.....
Bayshore	....	.....	3,350	.....
Boonville	....	.....	4,623	.....
Brocton	....	.....	4,050	2.70
Carthage	....	.....	1,500	2.50
Cohoes	9,900	.....	2,668	3.20
Croton on Hudson	....	.....	2,200	.....
Dolgeville	....	.....	5,170	3.40
Earlville	....	.....	7,200	2.43
Easthampton	....	.....	463	.....
Ellicottville	....	.....	11,059	3.63
Ellington	....	.....	2,246	.....
Elmira	12,323	.....	....	.....
Felt Mills	....	.....	850	.....
Forest Hills	....	.....	3,300	2.75
Frankfort	....	.....	1,340	2.65
Ft. Niagara	....	.....	7,150	2,517.00
Garden City	....	.....	8,400	3.25
Goshen	....	.....	300	.....
Hamburg	....	.....	1,120	.....
Harriman	....	.....	4,444	2.79
Hempstead	....	.....	3,600	3.25
Horseheads	....	.....	996	.....
Huntington	....	.....	3,844	2.64
Ilion	....	.....	12,700	2.75
Inwood	....	.....	3,352	3.30
Ithaca	....	.....	2,883	.....
Lancaster	....	.....	16,300	.....
Liberty	....	.....	10,055	.....
Lindenhurst	....	.....	848	1.95
Livingston Manor	....	.....	1,511	.....
Long Beach	....	.....	4,333	.....
Lydonville	....	.....	3,100	.....
Lyons Falls	....	.....	13,900	.....
Massena	....	.....	1,200	.....
Mechanicsville	....	.....	10,700	2.45-2.53
Medina	....	.....	20,650	.....
Milford	....	.....	3,300	1.97
Mt. Vernon	....	.....	3,550	2.69
Newark	....	.....	2,000	2.59
Newburgh	....	.....	16,258	3.53
New Hartford	....	.....	10,500	3.33
Northport	....	.....	18,700	2.60
Ogdensburg	....	.....	13,000	2.78
Orient	....	.....	6,570	.....
Ossining	....	.....	9,900	1.50
Oswego	....	.....	22,000	.....
Oxford	....	.....	3,300	2.00
Oyster Bay	....	.....	1,460	.....
Palmyra	....	.....	840	.....
Pt. Jefferson	....	.....	1,100	2.37
Phelps	....	.....	2,500	3.25
Rome	19,757	.....	....	.....
Scotia	....	.....	21,286	2.16-2.49
Syracuse	....	.....	9,720	2.10-3.50
Troy	35,000	3.65	16,200	3.00-3.80
Utica	28,624	.....	3,285	2.85-3.10
Wappinger Falls	....	.....	1,200	.....
Warwick	....	.....	12,200	.....
Westervliet	....	.....	37,598	2.46-3.25
West Carthage	....	.....	4,400	.....
White Hall	....	.....	10,090	.....
White Plains	....	.....	8,088	2.83-2.93
Yorkville	....	.....	4,381	3.25
Yonkers	12,936	.....	....	.....
North Carolina:				
Charlotte	....	.....	32,400	2.48
Cherryville	....	.....	15,000	.....
Greenville	....	.....	5,200	.....
Forest City	....	.....	2,000	.....
Hickory	56,971	.....	....	.....
High Point	18,279	.....	....	.....
Marion	....	.....	5,200	.....
Mocksville	....	.....	11,000	2.77
Morgantown	....	.....	12,000	.....
Pitts	....	.....	3,000	.....
Rowan	....	.....	15,000	.....
Rutherfordton	....	.....	10,000	2.40
Salisbury	67,783	.....	....	.....
Scotland	....	.....	3,000	.....
Winston-Salem	30,576	.....	2,000	.....
North Dakota:				
Grand Forks City	....	.....	98,300	437,499.00
Grafton	45,205	.....	....	.....
Ohio:				
Andover	....	.....	14,400	.....
Antwerp	....	.....	5,036	.....
Ashland	....	.....	4,344	4.02
Bellefontaine	....	.....	15,580	43,000.00
Bowling Green	....	.....	1,320	.....
Cincinnati	....	.....	10,750	.....
Columbus	....	.....	1,860	.....
Dayton	....	.....	31,030	101,000.00
Edgerton	....	.....	3,717	.....
Ft. Recovery	....	.....	4,333	.....

(To be continued)

NEWS OF THE SOCIETIES

CALENDAR

Apr. 3-5—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drake Hotel, Chicago.

Apr. 5-6—AMERICAN SOCIETY OF CIVIL ENGINEERS. Spring society meeting. Dayton, Ohio.

Apr. 10 — LINCOLN, NEBRASKA, CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS. Joint meeting with Nebraska Chapter, A. S. C. E., and student chapters of these two organizations at University of Nebraska.

Apr. 11—ENGINEERS SOCIETY OF BUFFALO. Engineers' Club, Hotel Iroquois. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Apr. 11—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago.

Apr. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 29, Massillon, O.; April 30, Youngstown, O.

Apr. 29—DETROIT ENGINEERING SOCIETY. Hotel Cadillac, Detroit, Mich.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

THE TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA

The Twelfth Annual Convention will be held at the Chamber of Commerce Building, Spartanburg, S. C., April 19-21.

PROGRAM, APRIL 19.

Morning Session.—Business Meeting. President's Address. Appointment of Committees on: Auditing of Accounts, Secretary and Treasurer. Nominating Committee Officers for ensuing year. Committee to select place of holding the next Convention. Exhibition Committee. Special Committee. New Business.

Afternoon Session.—"Laws Affecting the Operating of Public Utility Companies," by Geo. H. Moffett; "Laws Affecting Liability of Public Utility Companies, Occupying Highways with their Structures." by H. M. Callaghan. Sightseeing automobile ride.

Evening Session.—Address of Welcome, by the President of the Spartanburg Chamber of Commerce.

Response to Address of Welcome, A. J. Sproles. "Spartanburg, its History and Industries, Commerce, Homes and People," by E. B. Walker. "The Water Works of Spartanburg," by R. B. Simms. "The Electric Light and Power Facilities of Spartanburg," by Geo. B. Tripp.

Informal "Get Acquainted" Reception.

APRIL 20

Morning Session.—"New Fourteen-Million Gallons Concrete Filter Plant of the Water Department, Charleston, S. C.," by F. B. McDowell; "The Recent Drought in North Carolina and its Effects on the Water Supply," by H. E. Miller.

TOPICAL DISCUSSIONS ON WATER SUPPLY

What measures are you taking to protect your drainage areas and reservoirs from pollution by trespassers, such as hunters, fishermen, berry pickers, campers, construction camps and from the population residing on the drainage area?

Are you suffering from electrolysis, and what have you done to overcome the difficulty?

Is your water supply entirely satisfactory and is it acid or alkaline?

Have you experienced trouble with corrosion or incrustation of your water mains or service pipes?

Are you troubled with tastes, odors or algae?

Is your water free from bacteria?

What are you doing to overcome these difficulties?

Do you filter your water supply?

Do you chlorinate your water supply?

What results are you obtaining?

Afternoon Session.—"Accounting for Public Utilities," by C. L. Vann; "Mechanical Aids in Public Utility Accounting," by G. T. Moore; "Accounting Forms for Public Utilities," by R. E. Plimpton; "Distribution of Electricity from Central Stations," by H. F. Lee.

Collection of delinquent bills.

Collection of bills in case of transfer of property, and change of tenant between regular meter readings without notice to office of such change.

Does city pay for water, light and power for municipal purposes?

How do you measure water supply for sewer flushing and street sprinkling?

Do you have a regular plant schedule which provides for periodic inspection of all mechanical equipment?

Do you employ technically trained men to supervise your boiler room where your pocketbook is so vitally affected?

Are your demand contracts for power written on the kilowatt basis, while the actual load on is on the kilo volt ampere basis, tying up capacity without return?

Do you have frequent insulator troubles due to dust or other influences incidental to the industry supplied?

What has been your experience with joint occupation of poles with other utility companies?

Have you ever proven to your own satisfaction how often electric meters of different classes should be tested and overhauled?

Supper to Delegates and Guests—Compliments of the Spartanburg Water Works Commission and the Chamber of Commerce.

Evening Session.—"The Handling of the Public," by O. H. Bissell; "What South Carolina is Doing to Protect the Public Water Supplies and the Streams of the State," by E. L. Filby; "What North Carolina is Doing to Protect the Public Water Supplies and the Streams of the State," by H. E. Miller; What Georgia is Doing to Protect the Public Water Supplies and the Streams of the State," by H. C. Woodfall.

TOPICAL DISCUSSIONS

Emergency connections between public water supply systems and private water supplies for fire purposes; method adopted to prevent pollution of the city supply from private sources.

Discussion opened by a representative of the Underwriters' Association.

Continuation of Topical Discussion.

APRIL 21

Morning Session.—"Discussions of and Experiments in Hydrogen-ion Control of Colored Waters," by E. P. Verner; "The Installation of Underground Structures Previous to the Laying of Permanent Roadway Improvements. Upon Whom Should the Burden be Placed?" by W. S. Tomlinson. Five Minute Talks, by Representatives of Exhibitors.

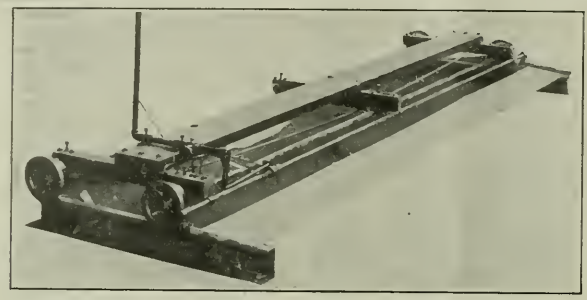
Afternoon Session. — "Reciprocating Pumping Engines," by R. D. Hall; "Metering Public Water Supplies, Experiences and Results Obtained," by C. N. Grantham; "Water Rates," by Wilder M. Rich.

Business Meeting.—Discussion of The Tri-State Water and Light Association, its Opportunities and Future, and What can be Done to Increase its Influence. Reports of Committees. Selection of place of holding the next Convention. Election and Installation of Officers.

Evening Session.—Popular Lecture, "Sanitary Engineering in the Holy Land," by H. Y. Carson, U. S. Captain of Engineers, attached to Gen. Allenby's Staff on his "push" to Jerusalem.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



THE LAKEWOOD FLOAT-BRIDGE AND FINISHING BELT

THE LAKEWOOD FLOAT-BRIDGE

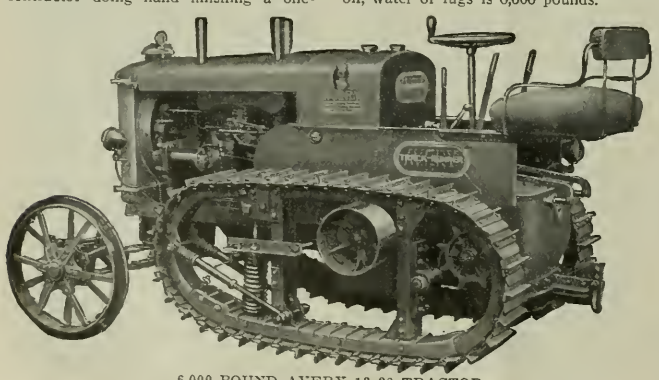
The Lakewood Engineering Company has brought out a new item of equipment for concrete road construction known as the Lakewood Float-Bridge, which is a hand operated belt float and substantial bridge combined. One man operates the lever which moves the belt back and forth across the pavement, at the same time automatically advancing the machine a little with each stroke. The traction mechanism can be instantly thrown out of gear so that the Float-Bridge can be pushed forward or backward. The belt can be raised off the pavement and is automatically held up until released.

On many concrete paving jobs it has been found that a final belting some little time after the pavement has been struck off, tamped, and surfaced, does much to prevent hair cracks and also gives a better surface. Time does not allow the finishing machine to go back and do this final belting, and it was primarily for this work that the Float-Bridge was developed. It gives the contractor doing hand finishing a one-man operated belting device. It provides a strong bridge across the road, carried on wheels traveling on the side forms, and is easily moved by one man.

NEW AVERY 12-20 TRACTOR

A new 12-20 h.p. tractor just put on the market by the Avery Co. is equipped with the Avery draft horse motor with four 4½-inch cylinders having a 6-inch stroke, making 800 rpm, and weighing 1,250 pounds. There is a direct drive, spur gear transmission and other Avery features and improvements. The machine can be operated on gasoline, or kerosene, or distillate fuel or on gasoline and kerosene mixed. It has two speeds of 2¾ and of 4¼ miles per hour, a wheel base of 80 inches, the front and rear tread are 42 inches and 48 inches respectively and the turning radius is 9 feet.

This tract is designed to include the best features of Avery improved mechanical construction with strength, simplicity, durability and efficiency. It is adapted for hauling, excavating and grading machines and trailers. The total weight of the tractor without fuel, oil, water or lugs is 6,000 pounds.



6,000-POUND AVERY 12-20 TRACTOR

INDUSTRIAL NOTES

Stroud & Co., Omaha, manufacturer of the "Little Red Wagon" and the Stroud elevating grader, has opened a branch at 640 Temple Court, Minneapolis, with J. C. Yetter in charge as sales representative.

The Westinghouse Electric & Manufacturing Co. has announced the following changes in personnel: R. L. Rathbone, branch manager of the Cleveland office, will take up special duties in connection with merchandising matters; J. Andrews, Jr., has been appointed manager in his stead of the Cleveland office, and C. D. Taylor succeeds Mr. Andrews in the Pittsburgh office. R. Seybold has been appointed manager of price statistics and will assist W. S. Rugg, assistant to the vice president in the latter's general duties. Also, W. R. Keagy has been appointed office manager of the Cincinnati office, and J. R. Deering, office manager of the Los Angeles office. H. S. Walker is to be promotion man in the Denver office, I. G. Cline in the Chicago office, and K. L. Graham in the San Francisco office.

The Barber-Greene Co., manufacturers of standardized material handling machines, Aurora, Ill., has added to its list of representatives the Good Roads Supply Co., Ford Bldg., Detroit, Mich.

The United States Cast Iron Pipe and Foundry Co., Burlington, N. J., has opened an office in Kansas City, Mo., with D. W. Pratt in charge.

The Federal Road Builders' Manufacturing Co. has been organized at Indianapolis for the erection of steel and concrete bridges, viaducts, etc., with Leo Traugott, Louis Traugott and A. Joseph as directors.

A. R. Hance, for six years in the sales department of the Bucyrus Co., in the Central and Eastern territories, has been appointed Northwestern sales manager for that company with offices in Portland, Ore.

The Chicago address of the Barber-Greene Co. has been changed from 11 S. La Salle Street to 9 S. Clinton Street.

PUBLIC SAFETY HEARINGS

The California Industrial Accident Commission announces four Public Safety Hearings to consider a General Safety Order for the operation of hoists and elevators on construction work and the re-adoption of Trench Construction Safety Orders.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 April 8, 1922 NO. 14

Engineers' Plans for State Health Boards

Laws of the several states requiring that plans for water works and sewerage systems be approved by the state boards of health, and rules and regulations of health boards relative to the preparation and submission of such plans

In a majority of the states, engineers, or the municipalities or public service corporations which they serve, are required by state law to obtain the approval of the state board of health for the plans of any water supply, water purification, sewerage or sewage treatment plants which they contemplate constructing. Many municipal officials, especially those in the smaller municipalities, are unaware that this requirement is a part of the state law or that they are under any obligations in the matter other than those imposed by local ordinances and finances.

Every engineer, however, who is engaged or hopes to be engaged in the designing and constructing of works of this character should be familiar with the legal requirements as well as the engineering features connected with such works. In spite of this, some engineers are apparently ignorant of these state requirements, while others seem to act on the general principle that they will go ahead with the designing and carrying out of the plans until interfered with by the board of health—that it is no concern of theirs and that it is up to the board to find out what is being done and stop it if it wants to and can.

This attitude of the engineer indicates either ignorance or narrowness of mind and a disregard of the best interests of both himself and his client. Everyone concerned will find the results much more satisfactory if there is from the outset a cordial co-operation and understanding between the state board on one side and the engineer and the municipality or corporation which he serves upon the other.

Where the submission of plans is required, many state boards have found it desirable to specify definitely what is required in the way of plans and explanations of them and it is to the advantage of the engineer to obtain from his state board the regulations covering such matters which the board has prepared and which it usually has in printed form for distribution, and to follow these in the preparation of his plans. He will thus frequently be saved the annoyance and expense of having to prepare additional or modified plans, and will thus frequently save delay in the approval of such plans and in beginning the construction of the proposed system.

In addition to requiring plans and reports, most of the state boards encourage an interview between the board and the engineer early in the preparation of his plans or in his study of the project, one purpose being that by such interview they may discourage at the outset the following out of certain ideas which they know beforehand will not receive their approval. In addition to this, they can frequently aid the engineer with information which he might otherwise not obtain or which he could obtain only at considerable expense of time or money. These preliminary interviews are not required in any state except North Carolina, we believe, and in some are not even suggested by the board, but we believe that all boards with engineering departments or officials would welcome such early consultation.

During the past few weeks we have been corresponding with the various state boards of health with a view to determining the conditions in each state relative to this matter and publishing these for the general information of engineers, believing that by so doing we will benefit the engineers and also make things easier for the state boards by encouraging cordial relations between them and the engineers. Also, we hope that this synopsis of the several sets of regulations as well as of the state laws may encourage a more intimate, beneficial and commonsense regulation of water works and sewerage matters by boards of health in those states where such control does not now exist.

PLANS REQUIRED

Taking up the states in alphabetical order, we find the following legal requirements for the submission of plans for water works and sewerage to the state health boards.

Arkansas. It is unlawful to build sewer or water purification plants or extensions of such plants without the approval of the state board of health.

California. Plans for sewerage and for water works must be submitted to and approved by the state board of health "on penalty of injunction proceedings." Plans are required for extensions only where these involve new sewer outlets or new sources of water supply.

Connecticut. Plans must be approved by state department of health before construction of sewerage and water works; also for changes in the methods of obtaining supply, in installation of purification works, deepening of wells, storage facilities, or any other changes in obtaining or handling a supply of water; also plans for any additional sewers not covered by previous plans.

Delaware. In this state there is no sanitary engineer and no control of water works or sewers.

Florida. In this state there is no state law giving the state board of health control over water works and sewers, but the board exercises a very complete control through the voluntary seeking of advice by municipalities and their engineers. The chief engineer, George W. Simons, writes: "To our knowledge no city sewerage job has been installed within the past four years without first having the plans approved by the state board of health. Engineers generally speaking are willing and ready—and I might add anxious—to submit their plans for examination and criticism."

Illinois. In this state it is illegal to install or contract for installing water works or sewers to serve more than 25 persons until complete plans have been approved by the state board of health. This applies also to additions to or changes in water works or sewers.

Iowa. The state law requires the approval of the state board of health for plans for the construction, extension or modification of a public water supply system or a sewerage or sewage disposal works or a garbage disposal plant.

Kansas. No person, company or municipality is permitted to supply water for domestic purposes to the public from any water works without a permit from the state board of health, nor to discharge sewage into any of the waters of the state without such a permit. (In this case apparently the works can be built without such permit, but as the health board could refuse the use of the works after they were built, ordinary precaution would lead to the approval of the plans before the works were started.)

Kentucky. Plans for water works and sewerage must be submitted to the state board of health.

Louisiana. Designs for sewerage and water supply must be approved by state board of health.

Maine. Water supply and sewerage are under the public utilities commission, and cities, corporations or individuals must obtain the approval of their plans for any system of water supply or disposal of sewage before petitioning the legislature for authority to introduce such a system. Since this law was passed in 1917, the commission has not been asked to approve of any plans.

Maryland. No municipality, company or person can install a system of water supply, sewerage or refuse disposal for public use, nor materially alter or extend an existing system, without the approval of its plans by the state board of health.

Massachusetts. In this state most of the water supply and sewerage systems are built under special acts, but the approval of the state department of public health is generally required.

Michigan. The state law does not require a permit before a sewer or water system is constructed or provide for submitting of plans until after the work is done. The state sanitary engineer, Edward D. Rich, feels that the law is seriously defective, but the department of health does the best it can under the circumstances. Some engineers, in arranging to serve a city or village,, stipulate that the plans which they prepare shall not be paid for until approved by the state department of health.

Mississippi. Plans must be approved by the state board of health before any water or sewerage system for public use is installed or an existing system materially altered or extended.

Montana. No water supply system, drainage or sewage disposal system shall be built, enlarged or extended without the approval of the state board of health.

Nebraska. It is illegal to install or enter into contract for installing any water works system or sewerage system to serve more than 25 persons until plans have received the approval of the state department of health.

New Hampshire. Approval by state board of health is required of plans for discharging sewage or trade waste into any water of the state "not hitherto polluted"; also of plans for supplying water for domestic use or enlarging an existing system.

New Jersey. It is unlawful to build a sewer, drain or sewerage system except under conditions approved by the department of health. The department requires approval of plans for changes or improvements to any water purification or treatment plant or any sewer system, or extension or alteration to any sewage system, or extension or alteration to any sewage purification or treatment plant, or plant for the purification or treatment of industrial wastes. Construction work on any such improvements may be enjoined by the court of chancery at the request of the department if plans have not been approved.

New Mexico. The Bureau of Public Health requires plans and petition for permit for furnishing or supplying water for domestic use or the modification or altering of an existing plant or system, where such system is to supply not less than 50 service connections. Plans and petition for permit are required for constructing a system or works for discharging sewage into any stream or other water used or intended to be used for human consumption or for domestic purposes or which may discharge into such water, or for maintaining a sewer farm or sewage treatment works; or for extending or altering any such system or works.

(To be continued)

Low Death Rate in Toledo

The 1921 death rate in Toledo is believed to be the lowest ever recorded there—12 per 1,000 population. In 1920 the rate was 13.86. Last year there was no death from measles, 7 from scarlet fever as against 24 in 1920, and 13 from whooping cough as against 27 the year previous.

Dredge Work on Illinois Ditches

Big clam shell bucket with floating equipment excavates and places 175,000 yards per month.

Very efficient and satisfactory work is being done in the construction of levees and ditches with clam shell dredges and floating equipment owned and operated by the Edward Gillen Dock, Dredge & Construction Co., drainage contractors, in the South Beardstown drainage and levee district, Illinois, and elsewhere in the same state. This company owns two all-steel Marion dredges with 45x 110-foot hulls, 110-foot boom, A-frame 85 feet, high, and a 5-yard Williams clam shell bucket; a 2-yard Monighan dragline excavating machine, a 12-inch hydraulic dredge, a 1 1-2-yard Marion dipper dredge and a 3-4-yard crawling traction dragline machine with which they have worked in the Beardstown district and at present are operating in the Thompson drainage and levee district, the Chautauqua drainage levee district, and the Liverpool drainage and levee district, all located on the Illinois river just above Havana, Ill., and employing altogether a force of about 60 men.

The levees are built up from the spoil excavated alongside in a ditch where the machine floats and the material handled varies from sand and gravel to blue clay with some deposits of peat. The levees are from 14 to 24 feet in height with slopes of 2½ to 1.

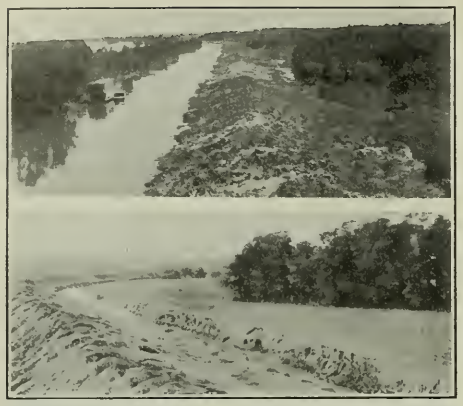
The 5-yard clam shell bucket dredge is operated by a crew of 5 men on each shift and has handled 150,000, 167,000 and 175,000 yards per month. In the South Beardstown district one of them handled 1,800,000 yards in 23 months and another handled 1,400,000 yards on the Thompson drainage and levee district in 15 months. They are able in some kinds of material to handle 7 yards per bucket every 50 seconds, although the bucket level full is rated at only 5 yards capacity.

F. P. Gillen writes:

"Several of the levees we are building have been badly washed on the inside on account of extremely high water, but we were able with the clam shell type of dredge to pick the top off and fill the back

FISH LAKE DITCH, BEARDSTOWN DISTRICT. DEEP SAND CUT IN CHAUTAUQUA DISTRICT MADE BY 5-YARD CLAM SHELL DREDGE.

MARION DREDGE WITH 5-YARD WILLIAMS CLAM SHELL BUCKET. 12-INCH HYDRAULIC DREDGE, MARION MODEL 21 CRAWLING TRACTION DREDGE. MONIGHAN DREDGE SUNK IN PEAT BOG, RALIANS SLOUGH, SOUTH BEARDSTOWN DRAINAGE AND LEVEE DISTRICT.



SOUTH BEARDSTOWN LEVEE FROM 14 TO 24 FEET HIGH.

slope, and then go on and build the levee up to grade and section; something that is absolutely impossible to do with a dipper dredge. We are also able with a clam shell dredge to reach out further and get material to top out levees. This same material could not be reached with a dipper dredge. In other words, we feel, after having used the clam shell type of dredge in building levees for the past eight years, that they are the only type of dredge to use in building levees."

Water Resources of New Jersey*

Data and principles used by engineer as basis of estimates. Plan of procedure suggested

BASIS OF ESTIMATES

In making the estimates, Mr. Hazen took advantage of rainfall, run-off and other data collected on the various watersheds in the northeastern part of the United States, the Pequannock gagings obtained from Morris R. Sherrerd and the Passaic gaging made by J. H. Cook being given greatest weight. In the calculations three square miles of water area were taken as equivalent in producing power to one square mile of land area and a correction for elevation at the rate of 0.64 inch of run-off for each 100 feet of average elevation was made. In calculating run-off from areas tributary to Long Hill reservoir, it was assumed that all but 2 per cent. of the total run-off would reach and be stored in this reservoir—that is, that only 2 per cent. of the total flows from the various drainage areas would occur in floods beyond the capacities of the reservoirs and tunnels to store and carry.

"The coefficient of variation for stream flow in New Jersey is taken as 0.24. This coefficient is an indication of the variability of the climate and of the possibility of the occurrence of dry years and of successions of dry years. The value selected is probably slightly above the truth but with limited data it is best to be safe.

"Another important index of flow is the ground water storage. This is expressed as so many days' storage. The Pequannock records indicate 30 days' groundwater storage. That is to say, for this stream the amount of storage to be provided is less than would be needed if the catchment area were all clay and rock by an amount equal to 30 days' supply. . . .

"Groundwater storage varies from stream to stream and the values used are based upon our own judgment. . . .

"Starting with the Pequannock where the amount of groundwater storage is known approximately from the records as 30 days, allowances for other streams are as follows: For all parts of the Long Hill reservoir area, 30 days; for the lower Raritan, the soil being less pervious, zero; for the Passaic, 30 days; for the Hackensack, 40 days; for the Mullica and Wading rivers, 60 days.

"With these assumptions and with the annual water crops shown in Table No. 3 and the reservoir capacities shown in Table No. 4,* the quantities that can be maintained from various areas and storage conditions are computed.

"The estimates relate throughout to a 95 per cent dry year. That is to say, they are made on the basis that by the best use of existing data it is probable that the full supply can be maintained for 95 of each 100 years. For the other 5 years there would be shortages. The deficiencies would range from 1 per cent. to 10 per cent. (and possibly to more than 10 per cent. at very long intervals) and would average about 6 per cent. in all the years of shortage, these being 5 per cent. of the whole number."

Mr. Hazen estimates that by developing the Long Hill project, using the Passaic as now developed, including the Wanaque reservoir and developing the Passaic Great Reservoir and developing the Raritan supply and utilizing groundwater and other present sources, there would be available 1,661 m.g.d., or more than six times the present rate of output; while the Long Hill and Raritan reservoirs could be utilized to full capacity by pumping into them Delaware river water, and the supply available thus be increased to 2,500 m.g.d., or about ten times the present rate of output, or nearly 500 gallons per capita per day in 1970.

DUAL SUPPLY SUGGESTED

Mr. Hazen suggests a dual water supply to be called possibly grade A and grade B, grade B water being drawn from some of the existing works now used for public supply after the encroachment of population has made them undesirable for domestic use. Industries can be served with grade B water, and since they are mainly on the lower levels and within limited districts, only a small part of the pipe system would need to be duplicated and the water would not need to be pumped. It would be heavily chlorinated so as to remove objections to it for sanitary reasons. It could be furnished at a lower

*Concluded from page 228.

*These tables are not reproduced here.

price per thousand gallons than grade A water and thus aid industry and afford a market for waters not suitable for domestic requirements.

PLAN OF PROCEDURE

In addition to considering the problem from a purely engineering standpoint, Mr. Hazen suggests a plan of procedure, as he had been asked to do by the Board of Conservation and Development. As he states, "the problem is to get co-operation or something to take its place. There is no community in the district that can carry alone an adequate project for the whole district, and there is no group of communities that can be reasonably expected to work together to do it."

The plan he proposes is to create a water board similar in most respects to that which constructed the Metropolitan water works system around Boston. This board would have the right to acquire existing sources of supplies, lands and rights, build water supply works, sell water at wholesale, and issue bonds to raise money to pay for the works, the bonds probably being state bonds. No contribution from state funds, however, should be permitted, but the money spent should all ultimately be recovered from the operations of the board. A board of three members is suggested as sufficiently large, but the members should be men of affairs capable of handling large enterprises efficiently and economically and who could decide all questions on their merits and without obligations to anyone.

This board, on being created, would at once proceed to take over some of the larger supply works now in service, which would form advantageous parts of a permanent general system, and would proceed at once to sell water from these supplies to the communities and companies now supplied from the existing works that were taken over. In order to distribute this supply to all the municipalities or water companies needing it, it would be necessary to acquire or lay a system of main pipes, making full use, however, of all existing pipes.

The prices should be such as to make the operations of the board self-supporting and might be readjusted each year. Takers in all communities should be charged the same rate, except that reasonable differentials might be determined by differences in elevation, in position or other conditions of delivery. Since those who first were served by this system would be charged higher rates than would obtain when more communities had come in, it would be only proper that those that connected with the system later should make some payment to the general fund to represent a proportionate part of capital payments charged off or amortized up to that time.

Meantime the board should immediately proceed to make studies and definite plans for the development of the additional supplies and then proceed to acquire the necessary sites and to develop the supply in installments, building them from time to time as the demand for water increased.

Mosquitos Breed in Trees

In campaigns for the elimination of mosquitos, the claims of the experts that mosquitos breed only in water are frequently received with disbelief by citizens because of the existence of mosquitos where they are quite certain there are no ponds or even tin cans or barrels containing water in which they can breed. Recently both English and American investigators have found species of mosquitos that breed in trees—that is, in holes in trees in which rain water stands sufficiently long to permit the development of the larvae. A committee of English scientists have found that no locality has been searched without finding in it breeding places of the anopheles plumbeus. These mosquitos bite freely, especially mornings but also at other times of day and night, between October and April. Females have been found in hollow trees with blood in them presumably of human origin. This species seems to breed exclusively in tree holes, the larvae feeding on organic matter consisting principally of insects that fall into the water.

A mosquito of similar characteristics, anopheles barberi, has been reported by Howard, Dyer and Knab as having been found in New Jersey, Maryland, Virginia, North Carolina, South Caroline, Missouri, Arkansas and Mississippi.

Plant for Separate Sludge Digestion

By George L. Robinson

Small plant at Bordentown, N. J., using a separation tank and sludge digestion tank.

Having read with much interest the recent articles on Imhoff tanks, it may be of value to your readers to describe very briefly a small plant using the principle of separate or outside sludge digestion.

The development and growth of the Manual Training and Industrial School at Bordentown, New Jersey, necessitated a second sewage treatment plant to receive the sewage from half the present population of some four hundred and to provide for additional growth of some two hundred.

To provide for this a plant was installed last June, designed to take care of a maximum daily sewage flow of 20,000 gallons. The per capita production is known to be not over 70 gallons.

The treatment tank is a modification of the Alvord tank used by the U. S. Housing Corporation. It is made up of three units—a separation tank, a sludge digestion tank, and a siphon dosing chamber.

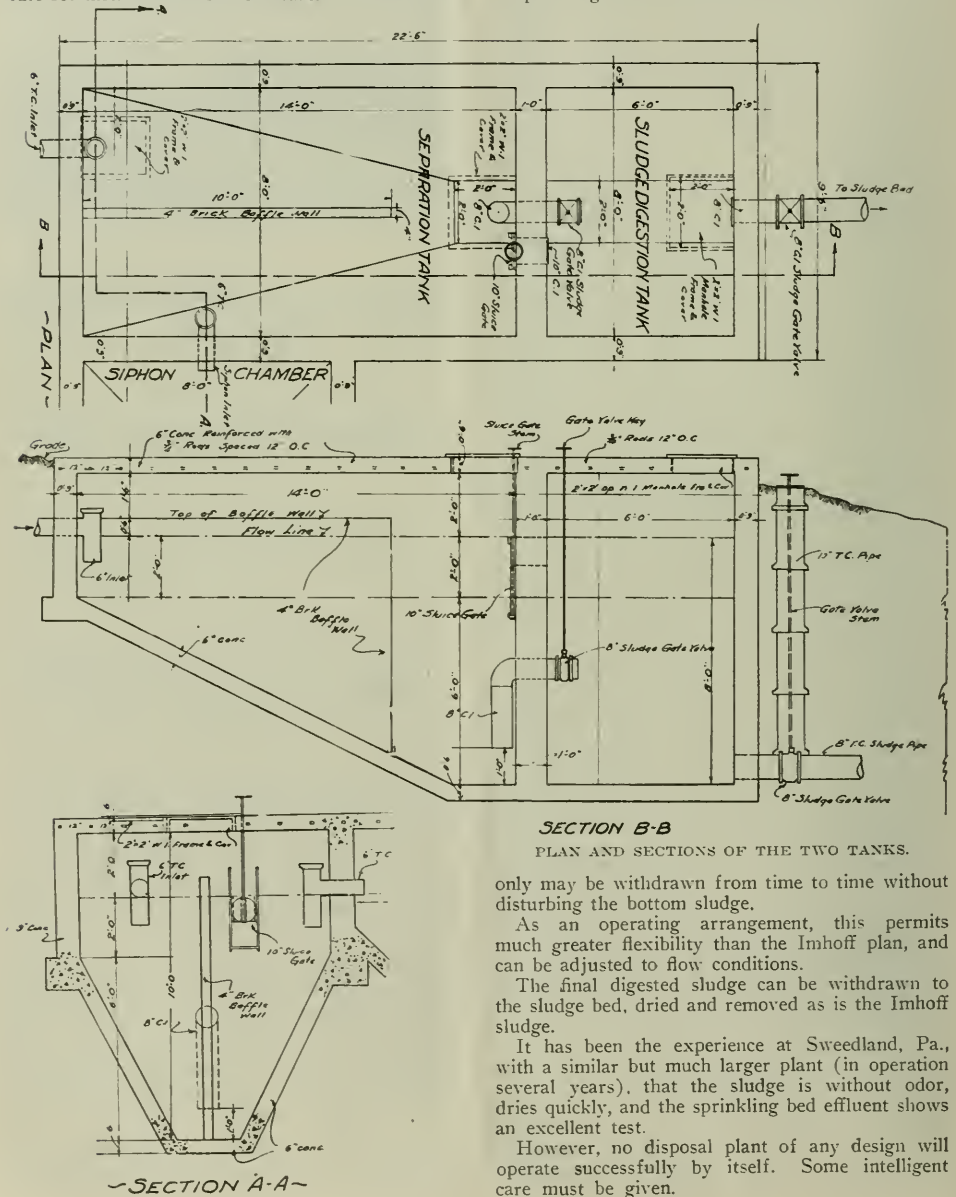
The separation tank is planned for a four-hour period of retention with due regard to the minimum flow at night. It is a reinforced concrete structure fourteen feet long by eight feet wide. There is a sloping floor giving a depth at the inlet and outlet end of two feet, and at the opposite end of eight feet. A four inch partition wall divides the tank on the long axis, causing the sewage to have a flow of more than sixteen feet from inlet to outlet.

Experience has shown that the floating mat is one of the most difficult problems to handle. Hence the *separate* sludge digestion chamber. This struc-

ture is eight feet by six feet by eight feet deep and is built adjacent to the separation tank. It is provided with an eight-inch sludge pipe and valve through which the digested bottom sludge may be withdrawn from the separation tank, and also a 10-inch sluice gate located 1 ft. below the flow line.

It is planned to dose the effluent from this tank over a broken-stone sprinkling bed at the standard rate for installations of this nature.

The advantages of this arrangement are—1. By withdrawing bottom sludge, the floating mat is lowered and mixed with the incoming fresh sewage, causing a breaking up of the mat and stimulating digestion of the floating particles. 2. The mat may be withdrawn into the digestion tank, mixing directly with the bottom sludge, and may be left standing for such time as may be required for complete digestion of the entire mass. 3. The mat



PLAN AND SECTIONS OF THE TWO TANKS.

only may be withdrawn from time to time without disturbing the bottom sludge.

As an operating arrangement, this permits much greater flexibility than the Imhoff plan, and can be adjusted to flow conditions.

The final digested sludge can be withdrawn to the sludge bed, dried and removed as is the Imhoff sludge.

It has been the experience at Sweedland, Pa., with a similar but much larger plant (in operation several years), that the sludge is without odor, dries quickly, and the sprinkling bed effluent shows an excellent test.

However, no disposal plant of any design will operate successfully by itself. Some intelligent care must be given.

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Submitting Plans to State Health Boards

We believe that most sanitary engineers, as well as sanitarians generally, approve of the policy of giving to state boards of health a considerable control over sewerage and water supply systems throughout their states. The men in charge of state boards and their engineers are only human, and may sometimes use poor judgment in making their decisions, be over-cautious in preventing the trial of new ideas, or exert their powers in matters that do not affect health. But there will be few or none, we believe, to dispute the statement that the general result of state health board control has been of great benefit to the health of the nation.

Sanitary engineers and public officials should therefore give their hearty co-operation to their state health boards, complying with all the regulations, and critizing only constructively and with a view to improving the service rendered by the board rather than to embarrassing it. This is desirable if only as a matter of policy, since the state board has the authority of the state behind it and can generally enforce its rulings or seriously inconvenience a municipality or company that refuses to act in accordance with them.

Many misunderstandings and hard feelings have resulted because municipal officials have been ignorant of the fact that a state board must be consulted in matters pertaining to water works or sewerage. Even engineers have been known to be ignorant of this, while others assume that they are under no obligations in such matter until receiving direct orders from the board.

With a view to remedying this ignorance of their legal obligations and to explaining just what is required and what is advisable in each state, we are presenting in this and a few following issues a brief statement of the laws and regulations in each of the states. These were obtained directly from the state health boards, most of which complied fully and freely with our request for information.

Some of the state health officials voluntarily expressed their approval of the idea of publishing this information. C. A. Emerson, chief engineer of the Pennsylvania Department of Health, says: "I believe your purpose in preparing this article is to be praised and the article should be of benefit not only to the engineers preparing the plans, but to the state health organizations to which the plans are submitted for approval." C. N. Harrub, director of the division of sanitary engineering of the Tennessee state board of Health, expresses the same opinion. V. M. Ehlers, of the Texas board of health, says: "We realize that this undertaking cannot but prove helpful to consulting engineers, and the review may be instrumental in simplifying and, so to speak, standardizing state requirements."

This article was prepared chiefly for the benefit of engineers, but it seems probable that it will aid the work of the state health boards also, and we hope it will promote a more sympathetic co-operation between them in carrying on the work in which both are engaged—the providing of safe as well as palatable water to all communities, and the removal and disposal of sewage with a minimum of danger and inconvenience to all concerned.

Model Engineers' License Law

The state license laws for engineers, which were discussed in our issues of March 25 and April 1, were most of them drawn up and urged by the American Association of Engineers, and this has been the chief reason for the very considerable uniformity found in both the letter and the spirit of the several laws. The society has evolved a "model" law which it urges the states to pass in order to secure this very desirable uniformity.

At the recent quarterly meeting of the national board of directors of the society, the board adopted an amendment to this model law "granting an engineer or surveyor registered in a state permission to practice in another state for not more than 90 days without being registered there, and without paying any fees, provided he files with the board of the state in which he is not registered a certified copy of his certificate of registration and also informs the board of his intention to practice, his address while in the state, the date of his work, and the approximate time required."

The above is not quite definite as to whether it

means 90 consecutive days, 90 days in one year, or 90 days of his lifetime, but we suppose it means that many days in one calendar year.

Another change provides that engineers employed by partnerships or corporations may sign and seal the plans prepared by the partnership or corporation.

Asphaltic Pavement Data

Our attention has just been called to a typographical error in the tabulation of paving data in our issue of March 25. In Table I, Part I, Sheet Asphalt and Asphalt Concrete, the columns are headed, "Warrenite-Bitulithic" and "Concrete." These headings should have been, "Sheet Asphalt" over the left two, and "Asphalt Concrete" over the right two. The column headings in Part II are correct.

1921 Road Construction in Illinois

The first pavement laid in 1921 on Illinois highways was in April, this being the first month in which pavement can be laid in that state under normal seasonal conditions. Considering the delays due to weather conditions and other causes, the maximum time that concrete can be laid in one season is approximately 120 days. Recently Mr. Piepmeier, engineer of construction of the Department of Public Works and Buildings of the Division of Highways of Illinois, has analyzed the work on the various contracts, and from it has prepared the following figures as to the actual number of days of working during the season.

Out of 102 independent pavers used in the State last year, one 21-E paver was operated 129 days, two were operated 121 days, two 105 days and the remainder less than 100 days. Fifty per cent of the pavers were of the 21-E or 4-bag type. The average for all mixers of this type, considering all jobs and all days on which the mixers were operated, was 371 feet per day.

A few special records were made. One 28-E paver (9-bag) in 10½ hours laid 1,434 feet of 16-foot pavement. In another instance, two different contractors on night and day shift with a 21-E (5-bag) paver, laid approximately 2,500 square yards. These two contractors also made several weeks' run of one mile per week, working double shifts.

Of the 102 paving mixers in operation, 20 were charged by means of industrial railroad equipment, 34 by central proportioning plants and truck delivery, 12 by central mixing plants and truck delivery, 8 from large storage piles upon the highway, and 28 from materials stored upon the sub-grade. (The 1922 specifications do not permit materials to be dumped on the subgrade.)

The tendency of the contractors in Illinois seems to be towards central proportioning plants with pneumatic tired truck delivery. The popular mixer seems to be the 21-E, and the popuplar size truck is either the one-ton Ford or the 2 or 2½-ton truck with short wheel base and pneumatic tires. The use of industrial track equipment for the delivery of materials has always proven its economy when topographical conditions were favorable. The central mixing plant has proven to be both desirable and economical on a number of sections of work where pneumatic tire trucks were used and where the maximum haul did not exceed 2½ or 3 miles.

The Cement Boycott

Wisconsin, one of the five states whose highway departments agreed to boycott cement until the price to them was reduced to $1.30 a barrel, has decided to be satisfied with the reduction already forced from the manufacturers and purchase the cement needed for its roads at the prices offered in recent bids—$1.41. A. R. Hirst, chief engineer of the highway department, believes this action to be desirable in order to prevent the loss to industry and labor that would result from longer holding up its road building program.

Brick Pavements in Florida

By E. C. Garvin*

Repressed brick laid flat on natural sand as base is common practice. Granite curb preferred to concrete

If we consider the Gulf of Mexico a small bay, like a depression in the irregular shore line of a millpond, the State of Florida will appear as a typical sandspit with the usual hills and hollows common to such formations. For street and road purposes the principal feature is the inexhaustible supply of sand.

Here as elsewhere economy demands the use of local materials in the construction of roads and pavements whenever such materials are suitable. Many Florida roads are built of shell and marl which are found mixed with the sand. These are soft in wet weather and dusty in dry weather and they break up readily under heavy and fast traffic. A more substantial material had to be found for city streets and main highways. Vitrified brick seems to have solved the problem in a manner quite satisfactory. There are several factors more or less local contributing to the success and economy of construction.

On the paved roads and streets there is a large volume of rubber-tired traffic and a marked absence of horse-drawn, steel-tired vehicles. The State law fixes a maximum load of 8,000 pounds for solid tired vehicles (including weight of vehicle), so pneumatic tires are quite generally used. In these circumstances brick streets are about as noiseless and as clean as asphalt under northern traffic conditions.

Where drainage is good, the natural sand foundation has proved successful on all but those roads and streets which carry fast moving or heavy traffic. The sand is very fine and ranges in color from pure white to a muddy yellow. While much of the sand is too fine for good concrete, it makes an excellent foundation, sand-bed and filler for brick pavements.

*Director of Public Works, St. Petersburg, Fla.

It is only necessary to grade the street or road, shape and roll the foundation, lay the brick, add the sand filler and the pavement is ready for traffic. The white sands are light in weight and are inclined to shift under the pavement.

Many miles of roads have been improved by the construction of brick pavements 9 or 10 ft. wide with cypress or concrete edging and with sand or marl shoulders. When vehicles are confined to such a narrow strip they naturally track each other. On foundations of the lighter sands this may result in the formation of ruts, the brick in the middle of the paved strips being pushed up until, in extreme cases, they stand up on end. Speeding is a common vice and the light sand filler may be drawn out of the joints, causing the brick to creep, shift and rattle under traffic.

Sands which contain some loam, clay or other impurity seem to work better than clean sands for foundation and filler purposes. When these are used, the faults above noted are much less pronounced. On paved streets and wide highways where traffic is better distributed, there is little tendency to the formation of ruts and the sand foundation and filler give good results.

Re-pressed brick are generally used. These are laid flat instead of on edge. They run about 38 to the square yard when laid flat in comparison with about 41 per sq. yd. when laid on edge. Lugs are omitted on the vertical sides and ends, for no matter how close together the brick may be laid, the fine sand will always find its way into the joints.

No clays or shales suitable for the manufacture of paving brick are found in Florida. Though the freight rate is high, resulting in a high cost of the brick, yet when the foundation and filler material arefound already delivered by nature along the right-of-way the cost of the finished pavement is quite reasonable.

Concrete curbing and edging are used to some extent but they do not seem to be entirely satisfactory. Granite curbing is imported and laid at a cost about equal to that of concrete, and the cost of inspection is less. In widening streets and roads, granite curb can be taken up and relaid with less breakage than is the case of concrete. For these and other reasons granite curbing is generally preferred.

Relaying brick pavements is a common practice. The original pavement on many roads was 9 ft. wide and on streets 20 ft. wide. Traffic requirements usually demand wider pavements before the brick are worn out. Brick that have been in use for 10 years or more in St. Petersburg have been taken up in the process of street widening and relaid without the need of any special adjustment of sand bed to take up the difference in thickness or depth of the old and the new brick.

In a country growing as rapidly as Florida it is almost impossible to lay and enlarge gas and water pipe and to make service connections fast enough to meet the demands. Cuts made for these purposes are easily, quickly and cheaply made in streets having a sand foundation and sand filler.

Where storm drains have been omitted and where traffic is apt to track, owing to narrow pavements, the sand filler has been abandoned for asphalt filler, but the sand foundation is still used except where traffic is heavy. Here we use a rolled shell or marl foundation as well as asphalt filler. For residential streets and for many country highways with satisfactory drainage, the sand foundation and sand filler answer every reasonable requirement.

Owing to high freight rates, the imported materials such as brick, cement, granite curbing, etc., are high in cost and a direct comparison of prices in Florida with prices elsewhere might be misleading. Contract prices for work now under construction in St. Petersburg follow: Earth excavation, 80c per sq. yd.; rock excavation $1.00 per sq. yd.; granite curbing 62c per lin. ft.; reset curbing, 15c per lin. ft.; brick, $2.65 per sq. yd.; and relay brick, 71c per sq. yd. There is reasonable assurance that contract prices for the new work to be advertised at an early date will be considerably below existing prices.

When St. Petersburg made up her mind to expand and grow the need of paved streets was fully appreciated. The haste was so great and the demand so urgent that the city's bonding limit was soon reached in paying her third of the cost of construction. A charter revision permitted the work to proceed with slight interruption. The abutting property now pays the entire cost including intersections. Although the city has power to order any street to be paved as a public necessity, the usual procedure is by petition of the property owners affected.

St. Petersburg has an estimated permanent population of about 20,000 and has about 80 miles of brick paved streets varying in width from 20 to 60 ft. She is now paving at the rate of about 15 miles per year. If funds can be raised for adequate storm drainage there is no reason to anticipate any let-up in the construction of street pavements for some years to come.

St. Lawrence Canal Opposed in Canada

One of the arguments advanced in this country against the proposed St. Lawrence canal is that United States money will be used for a project that will benefit Canada more than it will us. In Canada, on the other hand, objection is made that it will chiefly benefit the United States. This was one of the arguments made by representatives of the Montreal Board of Trade, the Shipping Federation, and the City Councils of Montreal, Quebec, Hull and Aylemer. These representatives presented their opposition arguments to the acting prime minister. W. S. Fielding, recently. They were told that the Cabinet had not yet considered the project seriously, and that there would be no appropriation for it this year.

Building New York Barge Canal

Although the New York state barge canal itself has been completed for several years, there still remains a number of related features to be carried out. For instance, bids are to be received on April 18th by the state superintendent of public works for completing the terminal in Rochester, widening the channel through the rock in the river bed from its present width of 100 feet to 200 feet for a depth of about 7 feet, totalling about 76,700 cubic yards, all of the rock which is to be excavated being below the water of the river.

Table No. 1—City Paving Done in 1921

Supplementary data to those published in the issue of February 18th, giving all returns received since the data first received were compiled. Continued from last week.

II—Warrenite-Bitulithic and Concrete

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
Ohio—Continued				
Hiram	....	.....	14,697	3.25
Ironton	....	.....	7,390	.....
Kent	....	.....	2,050	.....
Le Roy	....	.....	2,500	.....
Lodi	....	.....	1,863	.....
Mansfield	....	.....	1,160	.....
Marion	....	.....	4,415	.....
Marietta	....	.....	760	.....
Medina	....	.....	10,161	.....
Milan	....	.....	11,343	.....
Newark	....	.....	3,135	11,030.00
New Concord	....	.....	3,552	.....
Ney	....	.....	3,122	.....
Oak Harbor	....	.....	7,894	2.95
Pataskala	....	.....	10,163	.....
Piqua	....	.....	15,922	.....
Pleasant City	....	.....	6,198	.....
Shreve	....	.....	10,957	4.27
Springfield	....	.....	3,300	.....
Steubenville	....	.....	11,110	2.60-3.25
Wapakoneta	....	.....	4,111	2.90
Waterville	....	.....	1,250	.....
Wauseon	....	.....	6,448	3.50
Youngstown	....	.....	32,709	2.70-2.85
Oklahoma:				
Bartlesville	....	.....	15,750	2.95-3.98
Cushing	....	.....	12,812	3.20-3.35
Duncan	....	.....	6,000	.....
El Reno	....	.....	2,767	3.45
Enid	....	.....	8,814	2.97-3.30
Kingfisher	....	.....	31,156	.....
Norman	....	.....	10,823	27,059
Pontotoc	....	.....	8,500	3.15
Sand Springs	....	.....	24,000	4.09-4.19
Stillwater	....	.....	2,080	2.85
Tulsa	....	.....	202,836	3.60-4.73
Vinita	....	.....	6,336	3.79
Wilson	....	.....	6,800	.....
Oregon:				
Athena	9,774	.....	....	.....
Bandon	....	.....	2,110	3.50
Beaverton	12,817	.....	....	.....
Benton	....	.....	311	.....
Brownsville	22,470	.....	....	.....
Clackamas	....	.....	11,000	.....
Coquille	....	.....	2,800	.....
Cottage Grove	....	.....	560	2.22
Dallas	....	.....	17,590	2.74
Enterprise	14,532	.....	....	.....
Estacada	....	.....	785	.....
Forest Grove	12,024	.....	....	.....
Hillsboro	3,142	.....	1,155	.....
Marshfield	....	.....	14,355	2.50-3.00
McMinnville	....	.....	275	.....
Newberg	65,780	.....	....	.....
North Bend	....	.....	14,708	2.56-2.85
Pendleton	21,575	.....	....	.....
Polk	....	.....	9.32	2.20
Roseburg	....	.....	6,712	1.75-2.80
Silverton	....	.....	9,237	2.00-2.95
The Dalles	2,620	.....	....	.....
Tillamook	....	.....	373	2.99
Weston	8,281	.....	....	.....
Yamhill	....	.....	2,825	3.25
Pennsylvania:				
Allentown	....	.....	6,160	3.25-3.70
Altoona	....	.....	16,139	68,469
Bangor	....	.....	0.75‡	.....
Bellevue	....	.....	2,140	.....
Bethlehem	....	.....	10,310	3.34-3.59
Brookville	....	.....	4,300	3.80
Cannonsburg	....	.....	2,605	2.90
Carlisle	....	.....	5,953	3.75
Catasauqua	....	.....	556	3.24
Clarion	....	.....	5,709	.....
Coplay	....	.....	10,168	.89
Derry	....	.....	7,550	.....
Donora	....	.....	3,264	.....
Dormont	....	.....	6,080	1.98-2.70
Downington	....	.....	10,713	.....
E. Bangor	....	.....	14,736	78,490
E. Springfield	....	.....	420	.....
Edgewood	....	.....	9,112	.....
Fountain Hill	....	.....	11,700	3.75
Harrisburg	....	.....	12,661	3.90
Houston	....	.....	3,000	2.90
Johnstown	....	.....	7,232	.....
Kittanning	....	.....	9,231	2.98-3.60
Lansdale	....	.....	7,622	.....
Lewistown	....	.....	1,307	2.97
Lockhaven	....	.....	1,400	3.72
Manheim	....	.....	300	.....
Mercer	....	.....	783	.....
Mifflinburg	....	.....	10,000	.....
Muncy	....	.....	8,760	3.35
New Kensington	....	.....	8,000	2.25
New Liberty	....	.....	475	.....
N. Wilmington	....	.....	4,000	.....
Northampton	....	.....	651	3.15
Philadelphia	....	.....	16,116	49,153
Pittsburgh	....	.....	2,370	2.48
Pittston	....	.....	870	4.50
Port Carbon	....	.....	6,880	4.12
Reading	....	.....	10,002	2.65-3.29
Somerset	....	.....	1,650	3.25
Tamaqua	....	.....	660	.....
Tioga	....	.....	1,271	.....
Titusville	....	.....	7,080	3.11
West Easton	....	.....	5,600	3.98
W. Reading	....	.....	584	.....
West View	....	.....	14,831	3.10
Westwood	....	.....	4,330	.....
Wilson	....	.....	4,995	.....
Rhode Island:				
Newport	1,222	.....	....	.....
South Carolina:				
Aiken	....	.....	6,000	.....
Barnwell	....	.....	4,500	.....
Florence	....	.....	1,355	.....
Greenwood	....	.....	2,792	2.48
Newberry	....	.....	15,000	2.93
Richland	....	.....	172,620	2.52
South Dakota:				
Aberdeen	....	.....	1,833	2.28-3.65
Hot Springs	....	.....	28,831	3.62
Madison	....	.....	3,300	4.27
Milbank	....	.....	554	.....
Rapid City	....	.....	89,000	3.63
Sioux Falls	14,371	.....	8,620	2.69-2.85
Watertown	....	.....	16,634	2.62
Tennessee:				
Alcoa	....	.....	20,633	2.25-2.30
Athens	....	.....	22,365	2.58-2.73
Chattanooga	....	.....	1,780	2.44
Etowah	....	.....	9,004	2.75
Kingsport	....	.....	11,000	.....
Nashville	99,192	.....	....	.....
Texas:				
Abilene	....	.....	26,407	2.73-3.09
Austin	....	.....	1,707	.....
Beeville	....	.....	16,051	2.95
Belton	....	.....	20,000	3.06
Brenham	....	.....	26,956	.....
Brownsville	36,086	.....	....	.....
Clarksville	....	.....	32,220	3.25
Denison	....	.....	20,000	2.65
El Paso	68,116	.....	....	.....
Henrietta	....	.....	12,910	.....
Houston	50,810	270,701	3,727.50	.....
Itasca	....	.....	11,000	.....
McKinney	....	.....	6,000	2.10
Orange	....	.....	20,981	.....
Paris	31,999	.....	2,500	.....
Quanah	....	.....	4,677	3.25-3.50
Sherman	....	.....	1,256	.....
San Antonio	121,608	.....	7,800	.....
Temple	....	.....	2,000	.....
Utah:				
Garland	5,849	.....	....	.....
Mantl	....	.....	10,816	3.05
Provo	....	.....	9,953	2.00
Salt Lake City	....	.....	17,914	2.50-2.79
Springville	....	.....	30,000	2.65
Tremonton	17,122	.....	....	.....
Vermont:				
Bennington	....	.....	15,033	.....
Brattleboro	....	.....	2,600	.....
Enosburg Falls	....	.....	2,130	2.75
Montpelier	....	.....	5,190	.....
Proctor	....	.....	910	.....
Waterbury	....	.....	1,000	.....

Name of City	Warrenite-Bitulithic Area	Warrenite-Bitulithic Cost	Concrete Area	Concrete Cost
Virginia:				
Martinsville	42,581	.....	3,000	3.00
Newport	....	.....	3,381	.....
Portsmouth	....	.....	5,824	2.50
Richmond	10,252	.....	1,700	2.17
Roanoke	....	.....	25,994	3.30
Williamsburg	....	.....	15,883	.....
South Boston	50,424	.....	....	.....
Washington:				
Aberdeen	....	.....	30,642	2.80-3.10
Auburn	....	.....	1,377	2.00
Bremerton	....	.....	3,467	2.40
Burlington	....	.....	4,590	2.50-2.70
Centralia	....	.....	11,196	2.16-2.65
Charleston	....	.....	3,850	2.30
Colfax	....	.....	813	.....
Enumclaw	....	.....	900	2.95
Everett	....	.....	7,969	.....
Ferndale	....	.....	460	3.20
Lynden	....	.....	1,775	2.11
Morton	....	.....	6,915	3.73
Olympia	....	.....	1,612	2.40
Pe Ell	....	.....	11,917	2.87
Port Angeles	....	.....	1,400	2.75-3.50
Prosser	40,336	.....	2,575	2.35
Pullman	23,612	.....	4,130	.....
South Bend	....	.....	1,226	.....
Spokane	....	.....	66,030	.....
Stanwood	....	.....	600	.....
Tacoma	....	.....	64,826	2.35
Tappenish	1,985	.....	....	.....
Yakima	33,330	.....	13,303	2.28-2.47
Vancouver	7,029	.....	....	.....
West Virginia:				
Beckley	....	.....	9,768	3.25-3.65
Benwood	....	.....	16,560	2.85
Charleston	....	.....	14,574	3.15-6.10
Clarksburg	....	.....	9,919	.....
Clendenin	....	.....	2,710	3.65
Elkins	....	.....	5,556	.....
Huntington	....	.....	12,158	2.48-5.67
Kingwood	....	.....	4,500	.....
Montgomery	....	.....	5,681	3.90-3.95
Morgantown	....	.....	620	.....
West Virginia—Continued				
Moundsville	....	.....	8,160	2.75
Mt. Hope	....	.....	3,182	3.10
Pennsboro	....	.....	1,800	2.60
Princeton	....	.....	5,771	.....
Mt. Pleasant	....	.....	405	2.50
Reedy	....	.....	3,600	2.47
Richwood	....	.....	466	2.50
S. Charleston	....	.....	2,444	.....
Spencer	....	.....	6,482	2.88
Weston	....	.....	1,300	2.93
Wisconsin:				
Albany	....	.....	4,000	.....
Algoma	....	.....	900	.....
Ashland	17,110	.....	....	.....
Boscobel	....	.....	3,680	2.42
Denmark	....	.....	1,800	2.40
Elkhorn	....	.....	4,875	2.60
Grand Rapids	....	.....	6,518	.....
Green Lake	....	.....	33,778	1.77
Hartford	....	.....	21,000	2.87
Janesville	....	.....	12,222	29.705
Ladysmith	....	.....	3,000	3.00
Kewaunee	....	.....	3,000	1.79
Lafayette	....	.....	17,620	2.85
Marinette	....	.....	17,508	53,348.04
Mayville	34,285	.....	7,050	2.59
Necedah	....	.....	2,000	.....
Neenah	....	.....	17,600	2.46-2.56
Racine	....	.....	3,740	2.90
Rock	....	.....	27,107	2.56
Shawano	....	.....	15,619	2.58
Shorewood	....	.....	86,106	2.20-3.33
Stevens Pt	....	.....	3,800	2.80
Viroqua	....	.....	21,488	3.10
Waupun	....	.....	11,382	3.09
Wautoma	....	.....	7,643	1.90
Wauwatosa	....	.....	65,595	1.93-2.42
West Allis	....	.....	66,299	212,160
West Bend	....	.....	5,330	.....
West Salem	....	.....	3,966	.....
Whitefish Bay	....	.....	14,375	2.70-2.83
Wyoming:				
Thermopolis	....	.....	7,800	2.95

III—Asphalt Macadam and Tar Macadam

Name of City	Asphalt Macadam Area	Asphalt Macadam Cost	Tar Macadam Area	Tar Macadam Cost
California:				
Alhambra	627,747	14,314	....	.....
Connecticut:				
Stamford	....	.....	8,000	8,000
Georgia:				
Brunswick	1⅝†	19,809.94	....	.....
Kentucky:				
Ludlow	12,000	.....	....	.....
Maine:				
Lewiston	....	.....	19,000	1.80
So. Portland	....	.....	1,500	4,000
Maryland:				
Baltimore	53,500	2.00	....	.....
Hagerstown	6,270	11,000	....	.....
Massachusetts:				
Danvers	10,000	3.75	....	.....
Gardner	....	.....	20,000	.....
Greenfield	9,626	2.10	....	.....
Lee	....	.....	2,135	2.11
Lowell	13,181.10	.....	9,039.05	.....
Milton	9,438	2.18	4,319	1.28
New Bedford	....	.....	35,370	159,500
Taunton	25,155[a]	1.74-3.87	....	.....
Waltham	47,730	2.02	....	.....
Worcester	11,683	24,542	16,490	54,095
Michigan:				
Munising	4,300	1.92	....	.....
New Jersey:				
Rutherford	12,000	18,525	....	.....
So. Orange	3,000	....	....	.....
Westfield	....	....	20,000	46,000
New York:				
Carthage	21,000	2.25	....	.....
Malone	....	....	15,000	.....
South Point	....	....	1¼†	34,200
Pennsylvania:				
Athens	....	....	9,000	1.40
Bangor	....	....	4†	.....
Philadelphia	207,095	258,869	....	.....
Rhode Island:				
Bristol	30,000	3.45	....	.....
Texas:				
Cleburne	8,600	2.45	....	.....
Houston	6,061.50	2.45	....	.....
Lufkin	3½†	130,000	....	.....
Wisconsin:				
Eau Claire	5,053	1.30	....	.....

IV—Stone Block and Brick

Name of City	Stone Block Area	Stone Block Cost	Brick Area	Brick Cost
Connecticut:				
Ansonia	1,000	2.50	....	.....
Florida:				
Jacksonville	....	....	56,304[a]	4.26-6.66
Kansas:				
Independence	....	....	19,000	3.20
Manhattan	....	....	10,310	4.11
Louisiana:				
New Orleans	8,020	172,693	....	.....
Maine:				
Lewiston	272	....	....	.....
Rockland	408	9.97	....	.....
Maryland:				
Baltimore	52,100	5.02	12,470	5.68
Massachusetts:				
Boston	115,953	6.75	....	.....
Lowell	16,610.13	....	....	.....
Malden	11,668	5.60	....	.....
New Bedford	11,261	88,897	....	.....
Revere	20,000	7.25	....	.....
Taunton	3,780	5.26	....	.....
Worcester	9,850	80,400	....	.....
Michigan:				
Kalamazoo	24,100	4,005	....	.....
Mississippi:				
Vicksburg	....	....	9,100	41,000
New Jersey:				
Camden	6,300	41,580	....	.....
Rutherford	220	14.80	....	.....
So. Orange	6,500	3.70	....	.....
New York:				
Endicott	....	....	13,218	73,830
Jamestown	....	....	45,000	188,216
Troy	....	....	1,500	5.25
North Carolina:				
Washington	....	....	63,234	600,000
Ohio:				
Ashland	....	....	7,377	4.56
Barberton	....	....	648	4,030.45
Canton	....	....	27,722	99,037
Dayton	....	....	5,876	24,900
E. Cleveland	....	....	161,808	112,324
Oklahoma:				
Blackwell	....	....	26,437	3.15-4.10
Norman	....	....	1,143	4,024.48
Pennsylvania:				
Altoona	....	....	719.5	2,965.26
Carbondale	....	....	108,333	42,000
E. Bangor	....	....	1,910	9,156
Erie	....	....	2,373	5.70
Meadville	....	....	62,000	3.85
Philadelphia	605,394	2,555,667	46,289	224,978
Sharon	....	....	9,886	41,007
Woodlawn	....	....	11,993	4.75
Texas:				
Childress	....	....	25,000	1.30

II—Waterbound Macadam, Gravel and Cement Sidewalks

Name of City	Waterbound Macadam Area	Waterbound Macadam Cost	Gravel Area	Gravel Cost	Cement Sidewalks Area	Cement Sidewalks Cost
Arizona:						
Clifton	....	.....	35,000	$3,200	800	$600.00
Prescott	....	.....	.....	.....	3,300	1.80
California:						
Bakersfield	....	.....	.....	.....	42,611§	.22*
Richmond	....	.....	.....	.....	3,700	5,700.00
Colorado:						
Colorado Springs.	....	.....	.....	.....	2,087	1.90
Connecticut:						
Stamford	....	.....	.....	.....	45,965*	.....
Idaho:						
Pocatello	....	.....	.....	.....	451,954*	76,809.45
Illinois						
Oak Park	....	.....	.....	.....	40,500*	4,800.00
Indiana:						
Bicknell	....	.....	.....	.....	5,000	2.00
Logansport	....	.....	12,000◦	1.60	20,000‡	.16
Newcastle	....	.....	.....	.....	15,000*	.18
Wabash	972‡	3,496	.....	.....	.....	.....
Iowa:						
Creston	....	.....	.....	.....	10,000*	.25
Kansas:						
Manhattan	....	.....	.....	.....	5,700*	.185
Kentucky:						
Madisonville	1†	7,000	.....	.....	.....	.....
Louisiana:						
New Orleans	....	.....	7,088	26,807	41,693	84,433.00
Maine:						
So. Portland	1,600	.....	5,333	.....	950	2.75
Massachusetts:						
Boston	....	.....	.....	.....	88,741	1.75
Brookline	....	.....	.....	.....	5,542.76	.....
Gardner	15,000	.....	50,000	.....	6,000	.....
Lee	....	.....	.....	.....	1,700	2.23
Lowell	12,187.80	.....	48,775	.....	1,535.43	.....
New Bedford	....	.....	.....	.....	.....	37,814.00
Newton	....	.....	.....	.....	97,703	20,454.93
Peabody	....	.....	10,000	.....	.....	.....
Reading	....	.....	10,000	.60	.....	.....
Waltham	21,875	1.65	.....	.....	.....	.....
Watertown	....	.....	2†	1.15	141,566	.27
Worcester	....	.....	.....	.....	3,457	10,425.00
Michigan:						
Munising	....	.....	.....	.....	6,360*	.20
Port Huron	....	.....	.....	.....	10,126.47	.....
Saginaw	....	.....	22,600	24,010	.....	.....
Minnesota:						
Farmington	....	.....	.....	.....	.....	500.00
Missouri:						
Cape Girardeau	1,800	4,000	.....	.....	.....	.....
Monett	....	.....	50,000	.42	5,000	.148
Montana:						
Billings	....	.....	14,300	2,372	34,759*	9,265.00
New Hampshire:						
Lebanon	6,000‡	.....	2,000	.....	.....	.....
New Jersey:						
Rosele Park	....	.....	.....	.....	617	1,332.00
So. Orange	....	.....	.....	.....	20,000*	.18
Westfield	....	.....	.....	.....	5,000*	4,000.00
West New York	....	.....	.....	.....	10,000*	.30
New York:						
Auburn	....	.....	.....	.....	5,000*	.....
Endicott	....	.....	.....	.....	10,000*	1,600.00
Jamestown	....	.....	.....	.....	8,762§	9,433.90
Johnson City	....	.....	.....	.....	41,250*	7,420.00
Malone	....	.....	.....	.....	1,200	.....
Troy	....	.....	25,000	.....	.....	.....
North Carolina:						
Durham	....	.....	.....	.....	15,000	30,000.00
Washington	....	.....	.....	.....	10,227	.....
Ohio:						
Ashland	....	.....	.....	.....	5,000*	.24
Canton	....	.....	.....	.....	94,105*	3,463.00
Chillicothe	....	.....	.....	.....	.....	.....
Circleville	....	.....	400	28,000	4,130	5,575.00
Dayton	....	.....	.....	.....	12,000*	2,400.00
Newark	....	.....	.....	.....	1,192	1,908.23
Washington C. H.	....	.....	8,000	.....	.....	.....
Wilmington	....	.....	.....	.....	22,000*	6,600.00
Oklahoma:						
Altus	....	.....	.....	.....	7,000	1.80
Blackwell	....	.....	.....	.....	20,000*	.23
Wagoner	....	.....	1†	5,200	.....	.....
Oregon:						
Dallas	....	.....	3,600	.70	.....	.....
Pennsylvania:						
E. Bangor	....	.....	.....	.....	2,000	5,100.00
Jersey Shore	57,000*	1,900	.....	.....	46,250*	7,400.00
Meadville	....	.....	.....	.....	3,000*	.....
Sharon	....	.....	.....	.....	52,800*	1,322.00
Woodlawn	....	.....	.....	.....	2,743*	.24
Rhode Island:						
Cranston	....	.....	.....	.....	28,598	2.78
South Carolina:						
Union	....	.....	.....	.....	8†	.....
South Dakota:						
Rapid City	....	.....	.....	.....	10,000‡	.24
Tennessee:						
Greenville	....	.....	.....	.....	2,000	1.62
Texas:						
Brownwood	....	.....	.....	.....	16,800*	.....
Cleburne	....	.....	3,200	1.20	6,000*	.25
Houston	....	.....	196,622.50	.....	129	.....
Port Arthur	....	.....	.....	.....	22,000*	5,500
Washington:						
Olympia	....	.....	.....	.....	12,000	1.35
Port Angeles	....	.....	.....	.....	4,000§	.90
Wisconsin:						
Augusta	....	.....	.....	.....	5,000*	.18
So. Milwaukee	....	.....	.....	.....	2,000§	.18
Wyoming:						
Laramie	8,000	.....	16,000	.....	4,000§	.....

*—Square feet. †—Miles. ‡—Cubic yards. §—Lineal feet.

Recent Legal Decisions

CITY HELD AUTHORIZED TO CONTRACT WITH PRIVATE INDIVIDUALS TO SUPPLY INHABITANTS WITH WATER

Chapter 12, Minnesota Special Laws of 1879, organizing the City of Crookston, conferred upon the city power to make and establish public pumps, wells, cisterns and hydrants, and to provide the waterworks for the supply of water for its inhabitants for both public and private needs. The Minnesota Supreme Court holds, City of Crookston v. Crookston Waterworks, Power & Light Co., 185 N. W. 380, that such provisions vest the municipality with power to enter into contracts with private individuals for the purposes stated. Entering into such contracts and granting a franchise to individuals does not involve an exercise on the part of the municipality of its legislative or governmental functions as respects the rates and charges to be paid the grantees for a performance of the contracts, or otherwise, but only its proprietary powers, and the rules and principles of law applicable to contracts and transactions between individuals apply thereto.

CONFIDENTIAL DATA IN CITY ENGINEER'S OFFICE BECOMES PUBLIC BY PERMITTING INSPECTION

The California Supreme Court holds, Coldwell vs. Board of Public Works of City and County of San Francisco, 202 Pac. 879, that, data prepared by a city engineer's staff in connection with the construction of the city waterworks system having been permitted by the city engineer to be inspected by some citizens, the right to inspect the data cannot be denied to other citizens on the ground that it is privileged; it having lost its confidential character, if it had such, by being made public.

WHAT TERRITORY TO INCLUDE IN RESTRICTED DISTRICT HELD QUESTION FOR CITY COUNCIL

The Minnesota Supreme Court holds, City of St. Paul v. Scott, 186 N. W. 292, that what territory is to be included in a restricted residence district, established under Minn. Laws 1915, c. 128, is entrusted to the sound judgment of the city council. The fact that existing apartment buildings are not included and that certain residential territory is included does not justify the courts in holding the council's action arbitrary or void.

ORDINANCE PROVIDING FOR LETTING OF EXCLUSIVE CONTRACT FOR REMOVAL OF GARBAGE TO HIGHEST BIDDER HELD VALID

In proceedings for violation of an ordinance relative to the disposal of garbage, the Washington Supreme Court, State v. Lovelace, 203 Pac. 28, sustains the right of a city of the third class to enact an ordinance providing for the letting of an exclusive contract for the removal of manure, garbage, etc., and penalizing violations thereof; one of the most important functions of a city being to provide for the health of its inhabitants. Such an ordinance is not the granting of a franchise, since it simply provides the method by which the city proposes to take care of garbage, and grants no right or privilege; therefore the formalities of a franchise ordinance are not necessary to its validity. The ordinance was not void because it required the contract to be awarded to the highest bidder. It was in fact let to the person best equipped to do the work who would perform it for the lowest charge to the people served, and, if any revenue whatever was derived by the city, no showing was made to that effect. If any revenue was derived by the city, the court considered it would be merely incidental to the main purpose of clearing up the city at the lowest cost possible consistent with efficient results.

ASSESSMENT FOR TRUNK SEWER ON ZONE PLAN HELD NOT TO CONFORM TO STATUTE AND VOID

The Washington Supreme Court holds, In re Grandview Local Improvement Assessments, 203 Pac. 988, that an assessment for the construction of trunk sewers which took a general average of the cost per foot of the lateral sewers and assessed such amount against each foot of property abutting on the trunk sewer, regardless of the character of the different parcels of property or the special benefits conferred, if any, was not in accordance with the statute, which requires that the assessment shall be determined by ascertaining the reasonable cost of a local sewer suited to the requirements of the territory of the trunk sewer, not the reasonable cost of a local sewer suited to the requirements of some other locality, and such an assessment is void.

MUNICIPAL WATER PLANTS MAY REQUIRE CONSUMERS TO PAY COST OF EXTENSIONS OF MAINS

The Montana Public Service Commission, denying a petition for the extension of the water main of the city of Kalispell at the cost of the city, and holding that a rule requiring residents in new districts to pay the cost of extensions is not discriminatory, bases its ruling on the difference between a municipally owned and a privately owned public utility, the former being allowed to go into business only on the theory that thereby the public welfare will be subserved, and so far as gain is an object, it is a gain to a public body, and must be used for public ends. The Commission considers that this essential difference between the two kinds of utilities justifies it in allowing the local authorities wider discretion in the matter of main extensions, particularly where, as here, the question lies in the realm of policy, no positive discrimination or other unfair treatment appearing. The Wisconsin Railroad Commission, in Sand Water Co. v. North Fond Du Lac, recently expressed the principle as follows: "Obviously a municipally owned utility should exercise a somewhat wider discretion in determining the conditions under which extensions will be built than a privately owned utility, inasmuch as the former is presumably under the control of and representative of the public."

NEWS OF THE SOCIETIES

CALENDAR

Apr. 10 — LINCOLN, NEBRASKA, CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS. Joint meeting with Nebraska Chapter, A. S. C. E., and student chapters of these two organizations at University of Nebraska.

Apr. 11—ENGINEERS SOCIETY OF BUFFALO. Engineers' Club, Hotel Iroquois. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Apr. 11—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago.

Apr. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 29, Massillon, O.; April 30, Youngstown, O.

Apr. 29—DETROIT ENGINEERING SOCIETY. Hotel Cadillac, Detroit, Mich.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

The Annual Meeting of the National Highway Traffic Association will be held at the Automobile Club of America, 247 West 54th street, New York City, May 12.

Afternoon Session—2.00 P. M.

Report of National Committee on "Uniform Highway Signs," Chairman, Elmer Thompson, Secretary, Automobile Club of America. Report of National Committee on "Traffic Capacity and Widths of Highways Outside of Municipalities," Chairman, Herschel C. Smith, Assistant Professor of Highway Engineering and Highway Transport, University of Michigan. Report of National Committee on "Status of the Construction of Highway Curves and Recommended Practice to Increase Safety to Traffic," Chairman, H. Eltinge Breed, Consulting Highway Engineer, New York City. Report of Executive Committee on "Highway Improvement Creed" of the National Highway Traffic Association.

An informal dinner, at $1.50 per cover, will be served in the grill room of the club at 6.00 P. M. The public is cordially invited to attend.

Evening Session—8.00 P. M.

Report of National Committee on "Regulations Governing Speeds, Weights and Dimensions of Motor Trucks and Trailers," Chairman, George H. Pride, President, Heavy Haulage Company of New York City.

Report of National Committee on "License Fees and Motor Vehicle Taxation," Chairman, Henry G. Shirley, Roads and Sanitary Engineer, Baltimore County.

Report of National Committee on "Highway Transport Franchises," Chairman, F. W. Fenn, Secretary, National Motor Truck Committee, National Automobile Chamber of Commerce.

Report of National Committee on "Highway Transport Clearing Houses," Chairman, Tom Snyder, Secretary, National Association of Commercial Haulers, Indianapolis.

National Highway Traffic Association

Annual Meeting, Automobile Club of America, New York City, May 12th. Secretary, Elmer Thompson, 247 West 54th street, New York City.

ENGINEERING FOUNDATION

A meeting of the Engineering Foundation in co-operation with the National Research Council and the Municipal Engineers of the city of New York was held in New York on March 22. The subject of the meeting was "Destruction by Marine Borers: Is the Port of New York in Danger?" and the principal speakers, Hermann Von Schrenk, member of the San Francisco Port Committee; Chairman R. T. Betts, of the National Port Committee and the New York Port Committee, and C. M. Taylor, superintendent of the Reading Creosoting Plant of the Central Railroad of New Jersey and the Philadelphia and Reading Railroad. Lantern slides and speciments of shipworms and their destructive operations were shown.

ILLINOIS SECTION AMERICAN WATER WORKS ASSOCIATION

The fourteenth annual meeting was held at the University of Illinois, March 29-30. The program included, March 29: Address of Welcome, Eugene Davenport, vice-president, University of Illinois; Reports of the Secretary and Treasurer; Notes on Hydraulics of Wells by M. L. Enger; Ground Water History at Bloomington by D. M. Maxwell; Rockford Water Works by R. C. Wilson; Well Data and Water Works Pumping Equipment by John Oliphant; Park Ridge Pumping Station by W. T. McClenahan; Pubic Water Supplies in Illinois by H. F. Ferguson; Annual Dinner at the Inman Hotel and a paper on Some Phases of Stream Pollution by J. K. Hoskins.

March 30: Special Features of Recent Filter Plants by Paul Hansen; Water Purification Plant Operation and Analytical Control by M. W. Cowles; Use of Illinois Waters in Locomotive Boilers by C. W. Carrick; Some Data on PH and Residual Alum by A. M. Buswell, G. P. Edwards; Local Pollution of a Water Supply by F. C. Amsbary; Tastes and Odors, a Round Table Discussion, led by H. M. Ely; Iron Removal, a Round Table Discussion, led by A. M. Buswell; W. A. Hutchins; F. C. Amsbary, S. A. Greeley and G. C. Habermeyer; Motor Driven Centrifugals with Gas Engine Stand by W. B. Bushnell; Co-ordination of Water and Fire Departments by Clarence Goldsmith; Bond Issues for Water Works by C. B. Burdick; Collection by E. McDonald; Round Table Discussion on Office Records and Accounting, led by C. M. Roos and W. E. Lautz.

THE MUNICIPAL ENGINEERS OF THE CITY OF NEW YORK

At the March 22 meeting at the Engineering Societies Building, New York, the subject was Destruction by Marine Borers: Is the Port of New York in Danger? and it was stated that the loss in San Francisco Bay since 1919 is put at $20,000,000. Marine destroyers like those active at San Francisco, *Teredo navalis*, were found in Barnegat Bay last summer and the National Research Council has organized a national committee to study engineering, biological and chemical means of defense. Engineering Foundation is co-operating.

Chairman R. T. Betts, of the National Committee, a marine construction engineer, presented the plans of the National Committee, and for a New York Port Committee.

Col. Wm. G. Atwood, director of the investigation, presented a paper by Hermann von Schrenk, Ph.D., consulting timber engineer to a number of railroads; member of the National Committee and the San Francisco port committee.

Professor Thurlow C. Nelson, biologist at Rutgers College; discoverer of *Teredo navalis* in Barnegat Bay, and C. M. Taylor, superintendent, Port Read-

ing Creosoting Plant of Central R. R. of N. J. and Philadelphia & Reading R. R., dicussed the subject.

Lantern slides and specimens of shipworms and their destructive operations were shown.

LOUISIANA ENGINEERING SOCIETY

The regular meeting of the Louisiana Engineering Society was held in the Library of the Society, State Museum Building, New Orleans, on March 13, under the auspices of the Louisiana Section of the American Society of Civil Engineers. The technical exercises of the evening consisted of a paper entitled, "The Mouths of the Mississippi River." by Colonel E. J. Dent.

ENGINEERS AND ARCHITECTS CLUB OF LOUISVILLE

At the Regular Monthly Meeting, March 21st, Capt. J. R. Beam, Operation Officer, 88th Aero Squadron, addressed the club on "Aviation," and in the Civic Section, G. H. McClain, manager of the Louisville Safety Council, gave a ten-minute talk on, "The Clean Up and Paint Up Campaign."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The A. S. M. E. Spring Meeting will be held in Atlanta, May 8-11. Preliminary events will take place at Charlottesville, Va., May 6 and 7, in co-operation with the A. S. M. E., Virginia Section. Immediately following the Atlanta meeting, observation tours will be made to points in the South, including Birmingham, Greenville, S. C., Muscle Shoals and Pensacola, Fla. Information on this meeting will be forwarded to the technical press as it is available. Inquiries may be made to C. E. Davies, Assistant Secretary (Meetings), The A. S. M. E., 29 West 39th Street, New York City.

March 21, the Philadelphia Section held a Hydro-Electric Symposium. Joint meeting of the Engineers' Club of Philadelphia, Sections of A. I. E. E., A. S. C. E. and A. S. M. E. with the co-operation of the Hydro-Electric Power Commission of Ontario, Sir Adam Beck, chairman. The actual operation of the Chippewa Queenston Development of the Hydro-Electric Power Commission of Ontario was discussed with special reference to the 55,000 h.p. water wheels, put in operation in January.

SOCIETY OF INDUSTRIAL ENGINEERS

At the April 11 meeting of the Society of Industrial Engineers to be held at the Auditorium Hotel, Chicago, the subject will be "Standardization and Industrial Stability."

DETROIT ENGINEERING SOCIETY

A joint meeting of the Associated Technical Societies, of Detroit, was held at the Detroit Board of Commerce on March 17, which was addressed by John L. Harper, vice president and chief engineer of the Niagara Falls Power Co., on "Recent Developments at Niagara Falls."

CONNECTICUT SOCIETY OF CIVIL ENGINEERS

At its recent meeting the Connecticut Society of Civil Engineers elected the following officers: President, Robert J. Ross, First Vice President, Alfred H. Terry; Second Vice President, Clarence M. Blair, and Secretary-Treasurer, Henry J. Kellogg.

PUEBLO ENGINEERS' ASSOCIATION

The Pueblo Engineers' Association at its recent annual meeting discussed the subjects of "Flood Prevention" and "Cheaper Power for Colorado." The following officers were elected: President, H. K. Burton; Vice President, D. J. Cox, and Secretary-Treasurer, W. B. Curry.

WISCONSIN ENGINEERING SOCIETY

At its annual meeting held February 24-25, the Wisconsin Engineering Society elected the following officers: President, J. Donohue; Vice President, John C. White, and Secretary, Prof. L. S. Smith.

BROOKLYN ENGINEERS' CLUB

Industrial Brooklyn, paper No. 8, on "Brooklyn's Industrial Development," by Professor F. A. Rohrs of Columbia University, was presented at the regular meeting February 23. The making of soap and allied products was described in detail and moving picture films were used to supplement the description of the work and methods used by this great Brooklyn industry.

NATIONAL RIVERS AND HARBORS CONGRESS

The 17th annual convention of this organization opened in Washington, March 1st. Interest centered about the proposed Great Lakes-St. Lawrence ship canal and especially the public discussion between Governor Nathan L. Miller of New York; Governor Henry J. Allen of Kansas, and H. H. Merrick of Chicago, the former opposing the project and the latter two taking the affirmative side. President John H. Small of Washington, N. C. was reelected president.

THE AMERICAN BUILDING EXPOSITION

The American Building Exposition, which has been twice postponed by reason of the incompletion of the building, will open the new municipal auditorium, Cleveland, O., on April 22, to continue for a period of eleven days. The exposion will show every character of building material, interior decoration, finishing, furnishing and equipment, and an unusually interesting architectural display.

On the Arena floor, which is the main convention hall, there is a ceiling height of 60 feet and fully 90 per cent of the exhibits on this floor will be specially built for the occasion. Both the lumber and brick interests will show completed houses, fully landscaped, one of these exhibits being estimated to cost close to $25,000. The main exposition floor will carry exhibits of all that goes inside the home or commercial building. In addition there will be a machinery section in the corridors of the Arena floors. Approximately $100,000 worth of exhibition space will be sold.

Sponsored by the Builders' Exchange of Cleveland the exposition is being planned upon a cooperative basis by which the net earnings of the show will be rebated to the exhibitors, in reality permitting them to enjoy all the benefits of the exposition at actual cost.

BUSINESS DEPRESSION CONFERENCE

Research bodies and private individuals have contributed $50,000 for an exhaustive study of business depressions and practical means of their prevention. The F. A. E. S., the staff of the Dept. of Commerce, the Dept. of Labor, members of the Conference on Unemployment, U. S. Chamber of Commerce, the personnel of the National Bureau of Economic Research, Bureau of Railroad Economics, Russell Sage Foundation, Harvard Committee on Economic Research, American Association of Labor Legislation, Pennsylvania State Industrial Board, and others, have agreed to lend their co-operation and a conference will meet in the Department of Commerce, Washington, D. C., March 21.

PERSONALS

Thomas, E. R., city engineer of Port Arthur, Tex., has resigned.

Stringfellow, W. K., for the past eight years city engineer of Findlay, Ohio, died March 3.

Winslow, Burton L., of the engineering department of Akron, Ohio, has been appointed the first city manager of Stoughton, Mass.

Blodget, Edwin A., has been re-elected chairman of the board of water commissioners of Springfield, Mass., and A. R. Hathaway, clerk and registrar.

Keller, Charles F., superintendent of the water department of Lock Haven, Pa., has tendered his resignation to the city council to take effect April 1.

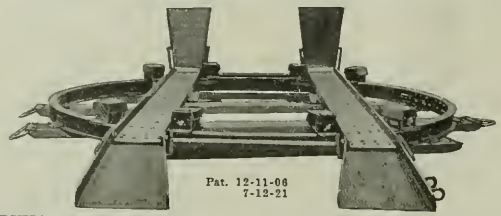
Walkup, W. H., formerly superintendent of the Batesville, Ark., water and light plant has been reappointed to that position succeeding P. M. Pierce, who resigned in January.

Martin, Alfred E., for 20 years superintendent of the Springfield, Mass., water department, died on February 21st.

Ireland, Major Mark L., Q. M. C., U. S. A., director of the Tractive Resistance of Roads Research being conducted by the Army with the aid of the Massachusetts Institute of Technology, at Cambridge, Massachusetts, has been detailed by the Secretary of War to represent the United States Army on the technical committee appointed by the Lincoln Highway Association to determine the design for the Ideal Section, which the association will construct this year for object lesson purposes.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



ROADBUILDERS PORTABLE TURNTABLE WITH ROLLER BEARINGS.

ROADBUILDERS PORTABLE TURNTABLE

The Roadbuilder's Portable Turntable manufactured by the Western Structural Co., is built in four sizes for trucks of one ton, three tons, four tons, and five tons capacity.

It consists of a circular track mounted on skids which serve for moving purposes. On the circular track is mounted the carriage which consists of a pair of runways with hinged approaches at each end. These runways are rigidly fastened together and near the end of each runway is attached a pair of flanged rollers or wheels, one roller on each side of the runway, said rollers being properly aligned to correspond with the circular track. It is constructed of structural steel except the cast iron rollers equipped with roller bearings, and the wood skids or runners.

The extreme height that the truck must rise above grade to mount the turntable is 10 inches, and with the easy approaches provided at the ends of the runways, driving on or over the turntable is accomplished without difficulty. Best results are obtained when the turntable is moved about 500 to 600 feet at a time, and the table is moved by a chain hitch to a road roller, passing truck, or any other convenient traction, which drags it to its new position.

This turntable is simple in construction and easy to operate. No mechanical attention is necessary, and there are no delicate parts or mechanisms which wear rapidly.

Since the turntable is placed just ahead of the mixer and on the prepared subgrade, its use will eliminate disturbance of the subgrade and any congestion which might arise, due to a truck being stalled in the mud or otherwise, if same were being turned around under its own power. It also eliminates the wear and tear on the truck incident to its being turned around in a limited space under its own power, but its chief advantage is in the saving of time.

The Henry W. Horst Co., of Rock Island, Ill., who are using several of these turntables, state that the time saving factor permits them to handle a road job with two trucks less than the number they would require without the use of a turntable. The machine can be easily operated by one man.

The J. J. Dunnegan Construction Co., Shenandoah, Ia., writes:

"We have used two of your turntables this past season for three- and two-ton trucks such as the Stoughton truck, and a lighter turntable for the Ford trucks. The main advantage in using turntables is in reducing the otherwise excessive strains produced by the turning around of the truck on the bare grade. In our opinion it is foolhardy to subject trucks to such unnecessary grief while turntables are available at nominal cost. We are also comfident that a turntable saves sufficient time of trucks to warrant the investment in a turntable. Furthermore, a turntable enables one to turn trucks on a very narrow grade a feat impossible to do with the truck itself."

AVERY "ROAD-RAZER" WITH SCARIFIER ATTACHMENT

The new Scarifier attachment for the Avery One Man "Road Razer" machine, manufactured by the Avery Company, tears up crushed stone and gravel roads or oil streets and then the three-section blade goes over the street or road and quickly smooths it down, making a smooth boulevard out of the rough road.

The City of Kokomo, Indiana, has an Avery "Road-Razer" with scarifier attachment which they are using in tearing up crushed stone streets. E. L. Danner, President of the Board of Public Works there, writes: . . . "Heretofore we have had a tractor with separate scarcifier and grader that we have used at a cost of $50 per day. The Avery machine does the same work in a very satisfactory manner at a total cost of $8 or $9 per day including man, gasoline and oil. It has ample power for all purposes, and we have no hesitancy in recommending it as an ideal machine for maintenance.

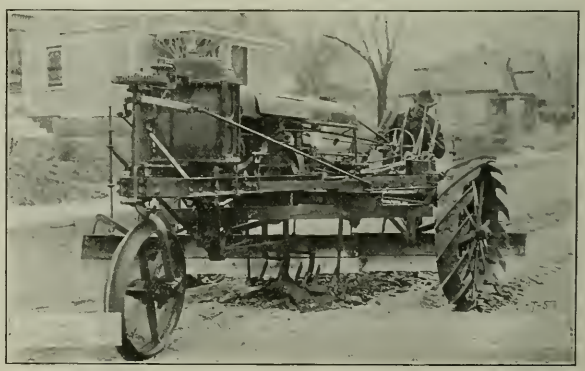
The Avery Road-Razer is also spreading gravel and crushed stone, making the grade level preparatory to laying concrete roads, removing snow from city streets and country roads and various traction jobs.

T. E. Burt, superintendent of streets, Flint, Michigan, writes that the rubber tire equipment is a big improvement especially for city work where you can drive over asphalt without cutting it.

INDUSTRIAL NOTES

The Good Roads Supply Co., Ford Building, Detroit, Michigan, has been added to the list of representatives of the Barber-Greene Company.

Wallace & Tiernan Company, Inc., have just issued a new technical publication, No. 30, describing their bacteriological testing outfit and other chemical testing outfits useful in the control of water purification.



AVERY ROAD RAZER WITH SCARIFIER ATTACHMENT

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 April 15, 1922 No. 15

Construction of Franklin Highway

By E. H. Sauerman*

Nearly ten miles of heavy grading and concrete surface, 60,000 yards of rock, boulders and earth handled by steam shovel and scrapers, hauled by tractors. Concrete materials delivered in batch boxes on industrial track from central storage. Aggregate trains hauled up steep grades by tractors. Side-hill platform storage for 3400 yards of stone and sand. Special brakes and safety drags.

The Pennsylvania State Highway between Franklin and Pearl in Venango county is an entirely new construction, 50,024 feet long, through heavy mountainous country, partly following the location of the old country roads and partly in new locations that involve some heavy grading, requiring about 60,000 yards of excavation that was chiefly done with steam shovel and tractor-hauled scrapers.

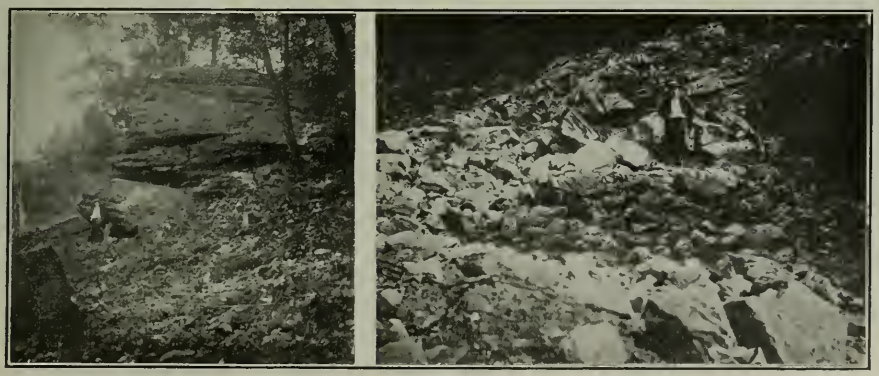
The section, officially known as "Route 233 Venango County," was built by the Pennsylvania State Highway Construction Bureau, the contracts being regularly inspected under the general direction and supervision of the Highway Department, Col. W. D. Uhler, chief engineer, and Paul Tells, chief of construction.

The excavated material was chiefly sandy loam and large boulders up to about 1,000 tons. A careful preliminary survey of the work convinced the Highway Department that many of the heavy boulders could be shot down the slopes at comparatively small expense, an assumption which was subsequently justified and meant a much smaller price for moving them than had been figured on by the contractors, who planned to break them up thoroughly and carry them away piecemeal.

* Formerly general superintendent for the Pennsylvania State Highway Department; now connected with the MacArthur Concrete Pile and Foundation Company.

HEAVY EXCAVATION

About 17,000 feet of the road is revision work, much of it through heavily wooded territory, where the grading was preceded by a 4-man axe gang chopping down all the timber, cutting it into 20-foot lengths and piling it alongside the right of way, where it became the property of the adjacent owners. The brush was burned and the stumps and roots were removed to a depth of one foot below subgrade, an operation easily and rapidly accomplished by the 10-ton tractors, which were con-



VERY LARGE BOULDER BEFORE BLASTING.

EFFECT OF DRILLING AND BLASTING SAME LARGE BOULDER.

nected to them with heavy chains eccentrically hitched so that the pull also twisted the stump. All the stumps were thus pulled out and hauled away to be burned.

The 60,000 yards of excavation included 5,300 yards of rock and was about one-half steam shovel work. The steam shovel had a special ¾-yard bucket with a manganese steel front and Panama teeth. It was extra wide and handled large boulders efficiently. It made about 25,000 yards of excavation and disposed of a large proportion of the waste material by side casting. Special pains were taken to complete the slope work with the steam shovel which trimmed it thoroughly and carefully at the probable expense of a few yards of daily output, which, however, was more than compensated by avoiding a return trip or costly hand labor. Two men with bars were kept working on the top of the slope, rolling all loose materials down to within reach of the shovel. In the Pecan Siding cut, 28 feet deep and 600 feet long, about 6,000 yards of heavy boulders and earth were removed in three weeks by one steam shovel and a 25-man gang. The boulders were block drilled and blasted and about one-half of the excavated material was side cast on the downhill slope, filling out about one-quarter of the width of the roadway. The remainder of the excavated material was loaded directly by the steam shovel into 1-yard dump wagons hauled an average distance of about 600 feet by six teams.

In this cut an 800-ton boulder was found projecting far into the right-of-way on the uphill side and the overhanging portion was removed by drilling six 8-foot holes across the boulder near the upper end and firing in them a charge of about 60 pounds of 40 per cent dynamite which shattered the soft sandstone so that the fragments that did not roll down the slope were easily handled by the steam shovel. The drilling was done with two Ingersoll-Rand DCR-13 Jackhammers, operated with air compressed by a portable gasoline machine with a capacity of 210 cubic feet of free air per minute.

Most of the rock encountered was sandstone varying from hard to soft, and was used for fills, but not for concrete aggregate, the latter being imported.

STEAM SHOVEL WORK

The steam shovel was supplied with water under gravity pressure through lines of 2-inch pipe up to 6,000 feet long wherever it was practicable to tap an elevated spring. On grades the shovel invariably worked upgrade in order to secure automatic drainage, but when operating on level ground where no gravity supply was available, the water was delivered to the steam shovel boiler by a domestic gasoline driven pump, mounted on wheels and installed at convenient springs, not more than 9,000 feet from the shovel.

In all the steam shovel work special attention was given to the slopes adjacent to culverts and bridges, where the slopes were made longer and wider so as to be certain to remove abundance of earth and avoid the possibility of having to return with men and wheelbarrows to do additional work at a much higher cost.

SCRAPER GRADING

Wherever the construction was along the old alignment, the excavation was done almost entirely without the steam shovel, the surface first being loosened with a heavy Western rooter plow and a heavy moldboard plow, both hauled by tractors, and followed by Baker-Maney scrapers hauled tandem in sets of three by each of two 10-ton tractors, making units that often handled from 150 to 200 yards a day, notwithstanding large boulders that considerably delayed operations. A rock cut of sandstone 4 feet deep was drilled, blasted and then removed by the Baker-Maney scrapers.

The scrapers of 1-yard capacity were easily filled and were attached to each other with special spring bumpers and short tongues so that no difficulty was encountered other than that due to the fact that in hauling over rough ground the jarring would sometimes accidentally dump a load, causing obstructions often liable to tear the train apart and making it necessary to place a man on each scraper to watch and control them.

FINISHING SUBGRADE

In cuts the steam shovel excavated a few inches below the required level so as to leave the surface not more than about one inch below subgrade. The forms were then set and after they had been carefully leveled, enough earth was thrown in between them from the shoulders to fill up slightly above subgrade elevation and was thoroughly rolled with the steam roller and finally finished with a Lakewood machine hauled behind the roller operated at about ¾ speed. In earth, clay or gravel this subgrader would cut 2 inches deep, but where soft shale or other hard material was encountered, it was first loosened by the scarifier attached to the steam roller, after which the grading machine was operated successfully to bring it within ⅛ inch of the required elevation, thus producing a very smooth, compact, uniform surface that was appreciated by the engineers and was economical in that it secured the exact amount of expensive concrete required for the hard surface. One steam roller was constantly operated behind the steam shovel, one behind the Baker-Maney scrapers and another was used for the fine grading.

Operations were conducted from Pecan siding, about midway between the two ends of the job, where there were established repair shops, office and commissary for labor and where plant and material were delivered by the railroad. The Pennsylvania State Highway Commission acquired an old hotel at Pecan siding and equipped it with bunks and commissaries, providing accommodations for about 75 men, the remainder boarding or living in the locality.

AGGREGATE STORAGE

The development of the facilities and operating arrangements at Pecan siding were made to conform to the topography and take advantage of the natural features of the valley and hillside. The siding of the railroad track was paralleled by a river 60 feet away and about 20 feet below it, that permitted the advantageous construction of a gravity storage plant and service track. The siding, which served as a material track, was paralleled by a standard gage track on which a locomotive crane, equipped with a clamshell bucket, was operated to unload gondola cars direct and to handle the aggregate dumped from "battleships," or large bottom-dump steel gondolas,

to a storage pile established on a timber platform 40 feet wide and 200 feet long floored with longitudinal deck planks laid on 12 x 12-inch transverse timbers which at one end rested on the beveled surface of the ground adjacent to the track and at the other end projected over the side-hill slope and were supported there on vertical posts, between which there were two lines of industrial tracks parallel to the crane track and siding. This platform had a capacity of 2,000 tons of broken stone and 1,400 tons of sand, which was retained by a longitudinal wall 2 feet high on the side nearest the crane track and by a similar wall 6 feet high on the opposite side, which was braced by diagonal tension rods running through the storage pile. The lower platform was made with heavy beams resting on the tops of the vertical posts and scabbed to them with 2-inch planks spiked to the posts only, and thus providing for easy disassembling, when the heavy timber will be uninjured and will yield 100 per cent salvage. About 45,000 feet b.m. of long-leaf yellow pine was required for the bin and platform.

There were set in the floor of the platform, over the two industrial tracks, twenty 12 x 12-inch openings, eight for sand and twelve for stone, that were closed by cast iron gates, operating in steel slides and easily handled from below by the trainmen, who can load a batch box in about 10 seconds. The average time for loading a trainload of 8 batch boxes with both sand and broken stone was two minutes. The cars were handled under the storage floor by a 3-ton Whitcomb gasoline locomotive that hauled them to an adjacent shed, where the required amount of 5 bags of cement was emptied into each batch box by hand, completing the loading of the train in about four minutes after the time when it was first delivered under the storage bin.

CEMENT STORAGE

The cement house, located between a railroad siding and the industrial tracks, was about 66 feet long and 30 feet wide, with a capacity for 11 carloads of cement. The floor was made with two cross layers of 1-inch boards with tar paper between the layers. The walls were made of 7/8-inch, square edge horizontal boards covered with battened tar paper. The roof boards were covered with 3-ply roofing felt, and the house was perfectly weatherproof. Before concreting was commenced, the storehouse was filled to capacity with cement in bags, which were piled so

HANDLING BOULDERS IN REVISION WORK.

10-TON TRACTOR HAULING THREE SCRAPERS.

SHOVEL FINISHING EXTRA WIDE SLOPE.

3-TON SHIFTING LOCOMOTIVE HAULING TRAIN OUT OF LOADING YARD.

TRACTOR IDLING DOWN 9 PER CENT. GRADE WITH TRAIN OF EMPTIES.

TRACTOR HAULING LOADED TRAIN UP LONG 9 PER CENT. GRADE.

FLEET OF TRACTORS FOR HAULING TRAINS ON HEAVY GRADES.

TRACTOR SKIDDING 25-POUND, 30-FOOT RAILS UP HILL.

FINISHING SURFACE FOR CONCRETE WITH SUB-GRADE MACHINE.

as to form independent walls adjacent to the sides of the building and thus prevent undue pressure against the latter. The space between these bag walls was filled with cement bags laid parallel to three transverse passageways, each 10-feet wide, that extended across the full width of the building and were left open to provide communication between to provide for loading and unloading with free communication between three large opposite doors on each of the long sides of the building, that opened respectively on the railroad siding and on the industrial tracks.

In each of these passages there was installed a Mathews gravity roller conveyor, which rapidly delivered the bags from the cars to storage, to batch box trains, or from storage to the outside loading platform where the batch boxes were filled. The conveyors were used as much as possible for transferring cement directly from the railroad cars to the batch boxes, thus avoiding rehandling and maintaining maximum storage so that at the end of the first season probably more than one-half of the cement originally stored in the house still remained there in reserve; which reserve, however, was used before the season closed.

CONCRETING

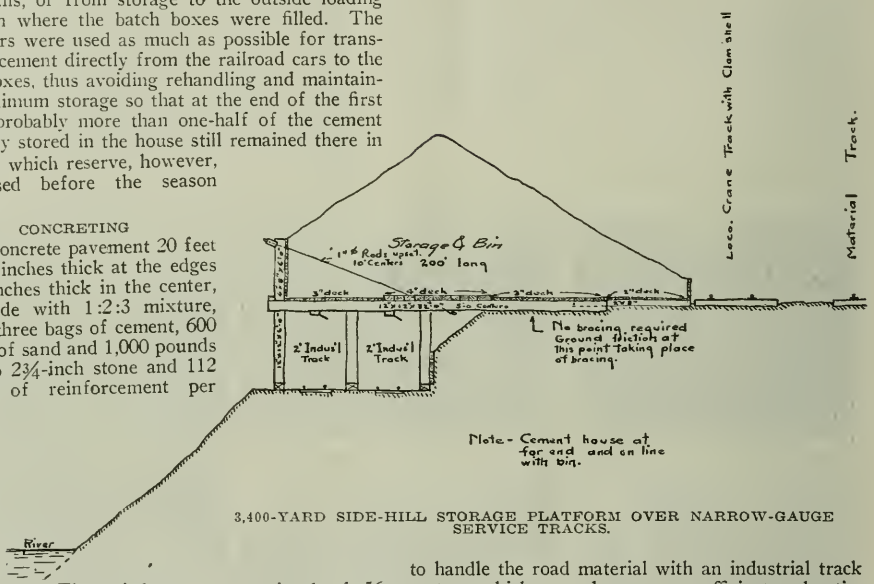
The concrete pavement 20 feet wide, 6 inches thick at the edges and 8 inches thick in the center, was made with 1:2:3 mixture, having three bags of cement, 600 pounds of sand and 1,000 pounds of ⅝ to 2¾-inch stone and 112 pounds of reinforcement per linear foot. The reinforcement consisted of 56 pounds National mesh fabric received in sheets 52 inches wide and 17 feet 8 inches long that were laid transversely across the road with an overlap of 4 inches. The position of the reinforcement in the body of the concrete was determined by laying the latter in two courses, the first course screeded to an elevation 2 inches below that required for the finished surface, after which the reinforcement was quickly laid and immediately covered with the finishing course applied within a few minutes after the bottom course so that both courses structurally formed a single monolithic course with the reinforcement imbedded in it in a substantially single continuous operation.

The culverts were all made of precast reinforced concrete pipe of from 14 inches to 48 inches diameter, made by the Musselman Company and laid with their ends set in concrete face walls which were built by the paver when it laid the concrete surface. The single concrete arch bridge of 10 feet span was built by the paver at the end of a season after it had finished road surfacing.

Concreting operations were commenced with the paver located about 8,000 feet from the Pecan siding, whence it advanced about 3½ miles to the Pearl end of the contract and then returned to the place of beginning and worked first upgrade, and continued in the same direction until operations were suspended for the winter with the expectation of reaching the opposite end of the contract, at Franklin, during the present season.

DISTRIBUTION OF AGGREGATE

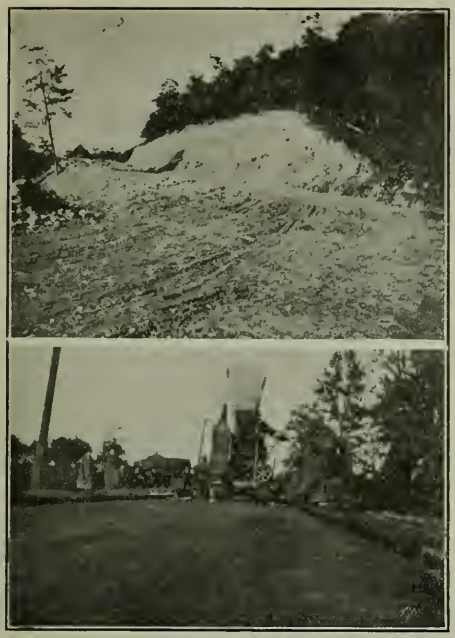
Notwithstanding that the alignment includes a 6 per cent grade 7,000 feet long, another 6 per cent grade 8,400 feet long and a 9 per cent grade 9,000 feet long with many curves in it, it was determined



3,400-YARD SIDE-HILL STORAGE PLATFORM OVER NARROW-GAUGE SERVICE TRACKS.

to handle the road material with an industrial track system, which proved even more efficient and satisfactory than was anticipated. The whole ten miles of the contract was served by an equipment of about 7 miles of 24-inch industrial track, with steel ties made by the Arthur Koppel Co. This provided enough track to reach from Pecan siding to the Pearl end of the contract, lay the necessary switches (of which there were eight) and double-track the grades. After this end of the contract had been completed, the track was removed and laid from Pecan to the Franklin end, thus serving the entire work.

The track was made up of 25-pound rails in 30-foot lengths, with steel cross ties and clips, assembled by the contractor in the field. When it was shifted as the work progressed, half a dozen or more lengths of track were neatly piled up and bundled together, placed on a timber skid and hauled to the new position by a tractor, thus saving considerable time and labor. The stiffness of the 25-pound rails and their length of 30 feet, eliminating many joints, produced an unusually rigid and satisfactory track that is recommended by the superintendent for similar service.



SIDE HILL STEAM SHOVEL CUT AND DOWN HILL EMBANKMENT
CONCRETE PAVER SERVED BY WHITCOMB GASOLINE LOCOMOTIVE HAULING BATCH BOX CARS ON INDUSTRIAL TRACK.

At central storage the aggregate was loaded into five-bag batch boxes, each provided with a separate cement container so tight that it was possible to leave the cement in them over night in the rain without injury. The batch boxes were loaded in pairs on flat cars, four of which were hauled in trains by gasoline locomotives running on the single-track industrial line, which at the three principal grades was double-tracked to permit the cars to be hauled both up and down hill by the tractors that moved on the subgrade alongside the track and clear of it and were connected to the forward car of the train by a 7/8-inch plow-steel cable 37 feet long, with a spliced eye at each end. This length of rope was found by experiment to be correct to avoid derailment, both 25-foot lengths and 45-foot lengths causing trouble because they frequently pulled the front cars of the train off the rails.

(To be continued)

Heavy Increase in Construction

In February last construction activities in the 27 northeastern states was 73 per cent. greater than one year ago, according to the F. W. Dodge Co.'s review. February building contracts in New York and northern New Jersey in February amounted to more than $59,000,000. The next largest district construction comes from the Central West district and amounts to $45,000,000.

MARCH CONSTRUCTION WORK

During March $293,636,000,000 of building construction contracts were awarded in 27 northeastern states, showing an increase of 65 per cent. over February and being the largest volume of construction in any month since April 1920, according to the F. W. Dodge Co. Public utilities amounted to 18 per cent. The largest amount of construction in any one of the five districts considered was $88,506,000 in New York State and northern New Jersey. Contemplated new work reported in March was $613,000,000.

Peekskill Bridge

A bill authorizing the construction of a bridge across the Hudson River near Peekskill, which was briefly referred to in PUBLIC WORKS March 11th, has been passed by the State Legislature and signed by Governor Miller and it is expected that the construction will be commenced promptly and prosecuted vigorously by the Terry & Tench Co., who have been interested in the promotion of the project.

The State has the right to take over the bridge after five years for $4,500,000, after 10 years for $4,000,000, after 15 years for $3,500,000 and after 20 years for $3,000,000 and after 25 years for $2,000,000, the bridge automatically becoming the property of the state without cost at the end of 30 years, if not purchased before. Toll rates are limited to from $.10 for children to $3.00 for loaded moving vans.

SIDE CASTING BOULDERS, BLOWN DOWN SIDE HILL.

Heavy Loads on Highways

Actual weights of heavy loads on Massachusetts roads. Many eighteen to twenty-ton loads. Methods of weighing and of enforcing law limiting loads

During the summers of 1920 and 1921 A. P. Porter, inspector, Division of Highways, Massachusetts Department of Public Works, was employed, under Commissioner John N. Cole, investigating heavily loaded motor trucks using the Massachusetts highways. He described his work before the Boston Society of Civil Engineers a few weeks ago as follows:

"We started to weigh the trucks with two loadometers. The loadometer is a device on the screw-jack principle, with an oil gage attached to give the weight. The two instruments are first placed under the rear axle, screwed up until the wheels are off the ground and the readings taken. Then this process is repeated with the front axle. The sum of the four readings gives the total weight of truck and load.

"In using the loadometers, I found it is wise to choose a spot where the roadway is nearly level in both directions, for if one of the jacks stands on the sloping shoulder of the road, the side thrust will cause the screw to bind, and not only work very hard but may affect the readings.

"During 1920, 90 trucks were weighed by the loadometers, and in 1921 100 trucks by the loadometer and 400 on platform scales.

"The first two jacks which I used were calibrated to 20,000 lbs. each, but the second pair, supposed to be an improved model, have a capacity of only 15,000 lbs. each.

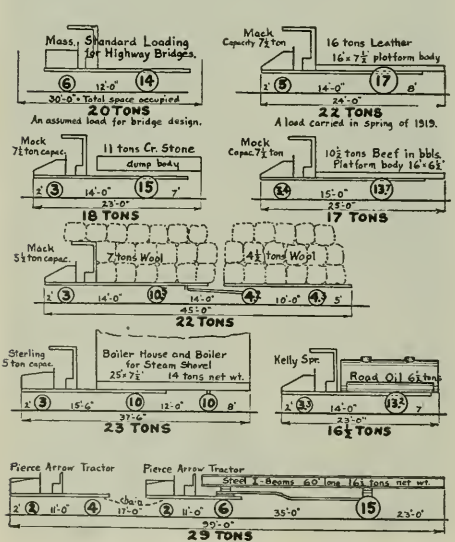
"The first truck I met after I began using these improved jacks was too heavy to be weighed with them and I had to resort to a neighboring 20-ton platform scale. The rear axle of this truck weighed 33,200 lbs., the heaviest axle load I ever weighed.

"The largest gross weight of a four-wheeled truck and load which we actually weighed was 38,300 lbs., and the largest load on six wheels was 40,000 lbs. The accompanying diagrams show the maximum loads we encountered. Undoubtedly there were some larger than these which did not happen to come our way.

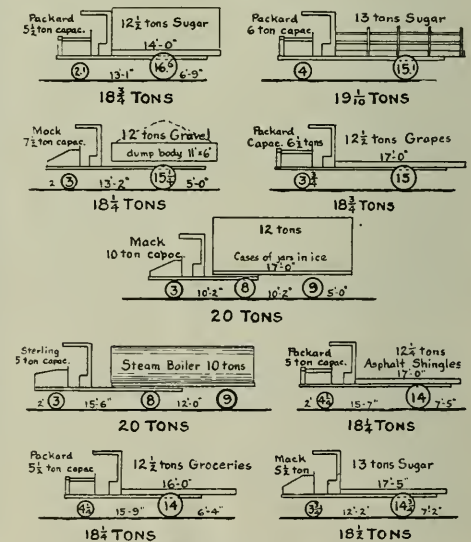
"The proportion of the weight which comes on the rear axle of a truck varies from 70 to 87 per cent. It is not constant for a certain truck. As more load is added, the percentage on the rear increases."

"It varies also with different makes of truck, different classes of commodities, length of wheel base, length of body, overhang, and how the load is placed. The Autocar has more of its load on the front. Loads of wool or cotton are sometimes piled forward over the cab. The average per cent. on the rear, for all makes, is about 78.

"The legal limit in Massachusetts for the weight



ACTUAL MAXIMUM LOADS IN MASSACHUSETTS IN 1920.



ACTUAL MAXIMUM LOADS IN MASSACHUSETTS IN 1921.

Load in thousands of pounds per wheel or ton per axle.

of truck and load is 14 tons, and outside the Metropolitan Parks and Sewerage districts there is also a limit of 800 lbs. per inch width of tire. Since the largest tire practicable is 14 ins. wide or its equivalent, two 7-in. tires, this practically limits the legal axle load to 22,400 lbs. even with the largest tires.

"When the weight of the truck and load was over the legal limit several hundred pounds or more, we summoned the driver to court. So far this year we had 116 cases in court and secured a verdict of guilty in 109 cases.

"Sometimes we made the truckman remove part of his load. On one occasion in Reading I stopped a truck going from Boston to Lowell which weighed 38,300 lbs., and another owned by the same company going to Lawrence which weighed 34,100 lbs. When told they could not proceed they telephoned to Boston for another truck, which came out and took 25 barrels of sugar off of one truck and 17 off of the other, which made this third truck overweight.

"When we started the investigation there were three facts we wanted to determine:

"1. *The Maximum Load.*—Actual weight of heaviest truck load and how its weight is distributed on the wheels. This is to be used as a basis for computing the greatest stresses in the pavement and in bridges.

"2. *Overloaded Trucks.*—The ratio of the actual load to the manufacturers' rated carrying capacity is called the "load factor." While we found some trucks carrying as much as two or three times the rated capacity, the average load factor for all the trucks carrying any load is about 1, and taking into account the trucks returning empty the average load factor is about 0.5.

"3. *Intensity of Traffic.*—A highway engineer is often called upon to compare the traffic over one road with that over another. For this purpose it is necessary to stop every heavy truck passing a certain point, ask the driver a number of questions regarding the weight of his truck and load, and find the total weight of all the trucks in a given period of time. I adopted 'tons-per-hour' as being probably the most convenient unit to express the volume of traffic. For instance, if one road carries ten times as many tons per hour as another, it is reasonable to suppose that the former road will wear out about ten times as fast as the latter and cost ten times as much to keep up, other things being equal.

"We divided the commodities carried into five groups:

"1. Crushed stone, gravel, etc.
"2. Oil, gasoline and tarvia in tank bodies.
"3. Groceries, meat and drinks.
"4. Wool, cotton and dry goods.
"5. Machinery, lumber and furniture.

"Our analysis of these figures shows some interesting conclusions; among others, that the loads going out from the city are very much greater than the loads going in toward the center. About 75 per cent. of the net load on any one of the through routes is going out from Boston, and only 25 per cent. coming in. If these could be more nearly balanced the efficiency of this kind of transportation would be very much increased."

Gasoline Trucks for Street Railway Cars

The distinction of being the first town in the United States where gasoline trucks are used exclusively for transportation purposes is claimed by Manhattan, Kansas. The Manhattan City and Interurban Railway Co. has decided to gasolinize its transportation system and four trucks are in daily service on the street railway tracks of the company. The cars used are of the four-wheel-drive type and are said to make a 5 per cent grade 2,500 feet long at 14 miles an hour. Each car has a seating capacity of 32 persons. They have electric starting and lighting devices, heating systems which utilize the heat from the motor exhaust, and weigh 7,240 pounds as compared with the 60,000 pounds weight of the electric cars.

Keeping Concrete Pavement Wet

Probably the method most commonly used for keeping a concrete pavement damp while curing is that of covering with earth which is wet down occasionally. In a number of instances, ponding is employed, but this is conveniently applicable only to roads that are practically level. The city of Seattle permits contractors to use either of these methods or, as a third alternative, continuous sprinkling.

Several years ago a contractor adopted the third method, using ordinary whirling lawn sprinklers, but these used excessive quantities of water and would be too expensive and unwieldy for a large contract. Recently another method of sprinkling has been used in Seattle which was devised by J. L. Smith, contractor for a 2½-mile improvement on a part of the Pacific highway in that city. W. H. Tiedeman, principal assistant city engineer, who describes this in the *Concrete Highway Magazine*, states that this is not only inexpensive and easily handled, but is, from the engineer's standpoint, a very efficient method of curing concrete.

"Mr. Smith had on hand from former county contracts, a large quantity of 1¼-inch pipe in about 20-foot lengths. These are coupled together with tees into which a ½-inch nipple, 3 inches long is screwed, and a stationary brass cap known as a "Mutt" sprinkler completes the installation. A simple adjustment of a screw regulates the amount of spray. The connected line is attached to a hydrant, which are about 300 feet apart in this city, and the concrete gang carries the connecting pipe onto the previous day's work, which takes only a few minutes. One man is employed to take care of the system during the day. On a recent job one-inch pipe was used and an even smaller diameter may prove sufficient for the supply line. Meters show that 41 cubic feet of water are used to wet 100 square yards per hour.

"The sprinklers are required to be in operation during the ordinary working hours, but in the summer months the night watchman is instructed to turn on the water about sun-up and to turn it off after sun-down. Our summer nights are always cool, so we do not expect serious evaporation to take place."

Mr. Tiedeman gives as additional advantages that the cost is small, costing the contractor less than an earth covering; it is simple to construct, it secures a

thorough and continuous wetting, and there is almost no expense for cleaning up afterward. It saves the destruction of parking strips by the storing on them of earth required for covering the pavement and also the tracking of dirt over the sidewalks, and leaves a perfectly clean pavement on completion.

Importance of Surface Finish of Pavements*

Life of a concrete road depends as much upon this as upon any other factor. Remedies for surface unevenness.

I believe that in a concrete road economically designed, the life of the pavement depends as much upon the surface finish as upon any other factor. We know now that impact is the great cause of destruction in our pavements. If the wheels of vehicles are smooth and the pavement surface is smooth there is no damaging impact from traffic. The road lives, even though it be weak in proportion to the volume and weight of traffic it must carry. But let surface irregularities develop, and no mater how strongly built, the whole pavement soon shows the effects of wear.

We build our roads on an average to withstand a pressure of 800 pounds per lineal inch width of tire. Yet, if an unevenness in surface of only ¼ inch occurs, the impact of one rear wheel of a five-ton truck may exert an impact pressure upon the road of 20,000 pounds. Under such pressure the unevenness becomes a depression whose edges spall and break, causing further impacts and more depressions until the pavement is badly damaged.

There are five general causes of unevenness in the pavement surface:

1. Foreign materials in the aggregate, which, failing to amalgamate, are ousted, leaving holes and depressions.
2. Non-uniform aggregates, which cause inequalities in wearing resistance to traffic, and subsequent depressions in the weaker places.
3. Poor workmanship in striking off and finishing.
4. Cracks, longitudinal and transverse, due to frost action, changes of temperature or unequal bearing power in the subsoil.
5. Uneven joints, perhaps the most common cause of surface trouble, due often to the piling up of joint material or to a difference in elevation of the slab surface.

The general remedies for surface unevennness are as obvious as the unevenness itself, and therefore, perhaps, as often neglected—strict enforcement of specifications exacting good material and good workmanship. Sometimes the letter of the specifications is violated, and frequently their spirit. When all engineers know their job so well that they can show contractors easier and better methods of doing their work, and when all contractors regard highway work as a legitimate industry and not a financial gamble, then we shall have that adherence to specifications that will insure good work and smooth surface.

Three general methods of preserving good surface finish once it is obtained, are the use of steel reinforcement; the division of the road longitudinally; and the wider spacing of joints with the use of dowels.

The advantages of steel reinforcement are that it gives the road greater bearing power and greater resistance to frost and that it offsets irregularities and weaknesses in the sub soil. By helping to preserve the integrity of the pavement it minimizes any tendency towards cracking, which is, of course, a cause of surface unevenness.

The division of the road longitudinally increases its beam strength about four-fold. Observation reveals that longitudinal cracks are not found in slabs 9 and 10 feet wide, though we have all encountered them in slabs beyond that width.

Transverse joints being a prolific source of trouble, it is well to diminish their number as far as possible through the use of the longer slab. This wider spacing of joints becomes feasible through the use of steel reinforcement to meet the temperature stresses of the slab. The use of dowels gives stability to the joints and holds the surface even. The submergence of joints an inch below the surface has proven unsatisfactory. Devised at first to secure a smooth surface and permit the use of a finishing machine, it seemed admirable until subsequent expansion crowded and crushed the concrete above the joint material, leaving a badly ravelled and spalled joint. The best method that I have found of making a joint is to submerge the joint material until after the screed or finishing machine has passed over it; then to lift the joint material slightly above the surface with long fingered tongs; then, to finish the joint with the split float or split roller, rounding the concrete next to the joint material with an edging tool.

The actual method of finishing is of course important in securing a smooth surface. Some road builders prefer to use the finishing machine with the roller and belt. It is essential that the roller be light. A too heavy roller pushes the crown out of the pavement, and spoils the surface. Most specifications call for a weight of from 12 to 15 pounds per foot length. Some builders omit the roller, using only the machine. My own experience indicates that the roller helps. One advantage of the finishing machine is that a dryer concrete can be used with it, which gives greater strength to the pavement. It also gives more uniform results than can be obtained with a green gang, and seems in general more foolproof than the hand method. Still, many prefer to strike off with the hand screed using the roller and belt. This has the advantage of making one piece of plant the less to get out of order and where a heavy screed is used in the hands of competent workmen it gives as smooth a finish as the finishing machine.

With either method the board belt gives unquestionably the best finish. The bow belt however, can give good results. Proper belting takes off not only the excess water, but also the clay loam, laitance etc., that tend to form a scale on the surface.

*Excerpts from paper by H. Eltinge Breed before the Good Roads Congress.

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City Streets and Highways

Twenty-five years or even ten years ago the vehicles carried by highways outside of the limits or immediate vicinity of cities were much lighter than those carried by streets in the freighting and manufacturing sections of cities. Motor traffic was confined almost entirely to passenger vehicles. Considering this fact and the greater number of vehicles, pavements on city streets were made both wider and heavier than those on the rural highways.

But this is no longer the case. If anything, the highways now carry heavier loads than most city streets. An article in this issue tells of loads of fifteen to seventeen tons on a single axle found using Massachusetts highways, and five to ten tons is common in most states. There would, therefore, appear to be no longer any reason for planning highways for lighter loads than city streets.

There are, of course, differences in conditions other than weight of loads. City streets carry more vehicles than highways. Some popular highways are crowded with vehicles on Sundays, but a count would show that even then the total number is less than are found on the busiest streets of the nearest large cities on a week day.

City pavements are cut into for water, gas and other public service pipes and structures, which seldom occurs with highways, and the several trenches under streets both present weak places in the sub-grade and furnish drainage of it.

These differences between the two must be recognized in planning, constructing and maintaining street and highway paving. On the other hand, because of the increasing weights of loads on highways, it can no longer be taken for granted that a highway pavement need not be so heavy as a street pavement; or, consequently, that it will be cheaper to construct.

Importance of Sub-Grade

Another article in this issue tells in detail of changes made in plans and designs for city pavements, as described to us by more than one hundred and fifty city engineers, and it is significant that most of these changes are apparently for the purpose of securing a stronger pavement. They include thicker base, richer mix, use of reinforcement, etc.

For the reasons stated above, if there is a necessity for making city pavements stronger, the same necessity is even more urgent in the case of highways, where the increase in weight of vehicles has been greater.

There is this to be remembered, however, while the wear of the traffic is borne by the surface, the weight is ultimately carried by the sub-grade. And the heavier the load, the more important this principle becomes. It is absured to expect any pavement to carry an axle load of ten, fifteen, or twenty tons by bridging or in any way except transmitting it directly to the sub-grade. If this is not firm at all points, breaks are sure to occur.

The heavier the loads carried by a pavement, the greater the attention that must be given to the sub-grade.

Co-ordination of Construction Methods With Local Conditions

To conform to standard construction practice and avoid experiments is a wise rule, provided standards are understood to be general principles and types considered as independent units. The modification and combination of such units to best conform to varying requirements and unusual conditions is one of the most important elements of successful engineering construction.

The essential features of ordinary arangements and equipment are capable of a great variety of combinations and modifications that, without involving new or untried features, may produce great efficiency and economy where adherence to the usual routine even with substantially the same elements, would be very unsatisfactory.

The contractor who best knows the potential value of the various kinds of equipment on the market and what general methods and operations are successful and the conditions under which they are most advantageous, and possesses the ability to analyze his problem, anticipate his principal requirements and difficulties and fit available facilities to

them with skill and ingenuity, will be a large gainer in the rapidity, excellence and lower cost of his work. The net result is that the items of the equipment selected co-operate to the best advantage, and that the methods are arranged in accordance with the probable and actual developments of the work.

These principles are especially pertinent to long sections of highway construction where topography, transportation facilities, and the character of the construction itself may vary greatly at different points. In such cases location of headquarters, distribution of plant, sequence of operations and the best combinations and utilizations of available plant applied in ordinary or novel fashion, afford a wide field for successful operation.

Examples of excellent results obtained in this manner are offered by the Franklin Highway construction, described in this issue, where an elastic system of distribution was obtained by combining the advantages of the abundant available supply of tractors with those of an industrial railway service; the elimination of brakemen's wages and the increase of safety by special car devices applied on the steep grades; construction of a simple platform on a narrow side hill to utilize limited storage space and facilitate gravity handling of materials, and the carefully prearranged handling of cement bags so as to keep a maximum amount in storage without rehandling and to substitute automatic mechanical conveyors for hand work.

Recent Changes in Pavement Design

One hundred and fifty cities report changes made last year or this in base, binder, cushion, joint filler, kind or proportion of aggregate, use of reinforcement, and other details.

In response to inquiries addressed to several hundred city engineers asking what changes they had made recently in the details of pavement design, more than two hundred informed us that no changes had been made. However, about one hundred and fifty reported some changes, most of them in brick and concrete pavements and in bases for pavements. These changes, classified according to the kinds of pavements, were as follows:

SHEET ASPHALT

Little Rock, Ark., has increased thickness of binder course to 1½ inch minimum.

Los Angeles uses water-worn pebbles, crushed boulders or quarried rock, instead of quarried stone only, and has changed base mix from 1:3:6 to 1:2½:5 and surface mix from 1:1½:3 to 1:2:3½. For asphalt wearing surface both fine and coarse mix are now used instead of fine only, with the following changes:

	Prior to Aug., 1921	Subsequent to Aug., 1921	
	Fine mix	Fine mix	Coarse mix
	Per cent.	Per cent.	Per cent.
Asphalt cement	10 to 12	9.5 to 11.5	7 to 9.5
Sand and stone dust	13 to 17	13 to 18	9 to 13
Pass 80 mesh	20 to 25	18 to 28	7 to 12
Pass 50 mesh	17 to 22	16 to 24	10 to 16
Pass 30 mesh	18 to 24	18 to 26	18 to 24
Pass 20 mesh	4 to 8	4 to 9	10 to 16
Pass 10 mesh	2 to 5	2 to 5	11 to 18
One-half mesh	.....	.....	6 to 12

Fort Lauderdale, Fla., uses 10-inch macadam base instead of 8-inch.

Logansport, Ind., has abandoned combined curb and gutter, using curb alone, either monolithic with base or superimposed on it.

Fort Dodge, Ia., has reduced penetration required for wearing surface.

Topeka, Kan., has increased thickness of base from 5 inches to 6 inches.

Wichita, Kan., has reduced penetration of A. C. to 45 on traffic streets.

Madisonville, Ky., will use brick gutters on a 4-inch concrete base.

Lorain, O., will use concrete base 8 in. thick at center and 5 in. at sides of street.

Oil City, Pa., is changing from 1½ in. top and 1 in. binder to 1 in. top and 1½ in. binder.

Wilkes-Barre has changed the thickness of base under asphalt from 6 in. to 9 in. on the main thoroughfares.

Denton, Tex., will use 4 in. and 5 in. plain concrete base with 2 in. rock asphalt surface.

BRICK

Base

St. Petersburg, Fla., uses shell or rock foundation instead of sand in some cases.

Bloomington, Ill., has increased base for brick from 4 in. to 5 in. in residential streets.

Danville, Ill., is using a richer mix, and greater thickness for its base on heavy-traffic streets.

Mattoon, Ill., is changing from 5 in. to 6 in. thickness of base.

Waukegan Ill., has changed its mix. for concrete base from 1:3:6 to 1:3:5.

Chanute, Kans., has changed the thickness of concrete base from 5 in. to 6 in.

Emporia, Kans., has changed the thickness of concrete base from 4 in. to 5 in. and the mix from 1:3:6 to 1:3:5.

Ashland, Ky., has changed thickness of base from 6 in. to 8 in.

Sedalia Mo., intends to use heavier base than the 4 in. in residence districts and 6 and 8 in. in business that are now used.

Lexington, Neb., has increased thickness of concrete base from 4 in. to 5. in. and will increase it to 6 in. on heavy-traffic streets.

Johnson City, N. Y., is paying more attention to the water used in mixing the concrete.

Ashtabula, O., contemplates reinforcing concrete bases.

Jackson, O., is increasing the thickness of base 1 in.

Lorain, O., brick will have concrete base 7 in. thick at center and 5 in. at sides.

Painesville, O., has increased the base from 5 in. to 6 in. and 8 in. on heavily traveled streets.

Blackwell, Okla., is using a heavier base.

Greensburg, Pa., has substituted for base 8 in. of crushed furnace slag instead of 6 in. of granulated slag.

Greenville, Tex., has increased thickness of concrete base from 4 in. to 5 in., and uses graded aggregate in place of bank run.

Augusta, Wis., will lay brick on sand foundation.

Cushion

Bloomington, Ill., has reduced sand cushion from 2 in. to 1 in.

Chicago Heights, Ill., is using 1 in. sand cushion mixed with 20% of cement.

Mattoon, Ill., is changing from sand to bituminous mastic cushion.

Omaha, Neb., has changed from sand cushion to sand-cement cushion.

Huntington, Pa., in 1921 changed from cement-sand cushion to straight sand.

Brick

Bloomington Ill., will use some 3-in. brick.

Streator, Ill., proposes to use 3-inch vertical fibre brick on 4-inch concrete base.

North Tonawanda N. Y., has begun use of 3-inch vertical fibre brick on 4 in. to 5 in. concrete base.

Jackson, O., is using 3½ in. brick.

New Boston, O., is dispensing with nose brick along street railway tracks.

Sewickley, Pa., is now using 3-in. brick instead of 4 in.

Longview, Tex., has changed from 3 in. brick to 2½ in. on residence streets.

Filler

St. Petersburg, Fla., has changed from sand filler to asphalt filler.

Chicago Heights, Ill., is using elastic filler instead of grout.

Mattoon, Ill., is changing from cement to bituminous mastic filler.

Murphysboro, Ill., will use asphalt filler for brick pavements.

Grand Rapids, Mich., has changed from cement grout to asphalt filler.

Binghamton, N. Y., has decided to use bituminous filler excusively.

Johnson City, N. Y., is paying more attention to the making of bituminous joints.

North Tonawanda, N. Y., is using asphalt filler with vertical fibre brick.

Bucyrus, O., is using soft filler instead of cement grout.

Greensburg Pa., has substituted asphalt filler for sand.

Rankin, Pa., has changed from cement grout filler to oil asphalt.

Wilkinsburg, Pa., is using oil asphalt filler instead of cement grout or sand.

Parkersburg, W. Va., has changed to asphalt filler except in street car tracks.

CONCRETE

Thickness

Napa, Cal., has increased thickness from 5 in. to 6 in.

San Bernardino, Cal., has increased thickness.

Norwich, Conn., has increased thickness to 7 in.—1:2:4 mix.

Ames, Ia., has increased the thickness to 8 in., using reinforcement.

Paducah, Ky., may increase thickness—now 6 in.

Gardiner, Mass., old design 6½ in., now uses not less than 7½ in. reinforced.

Pittsfield, Mass., has changed thickness from 9 in. and 7 in. to 8 in. and 7 in. and from plain to reinforced.

Hastings, Mich., has changed from 6 in. to 7 in.

Webster Grove, Mo., has changed from 6 to 6½ and 7 in. on residence streets, and from 8 in. to 8½ in. on through roads.

Camden, N. J., increased to from 7 to 10 in. according to traffic.

Little Falls, N. Y., will make all concrete 8 in. thick, with reinforcement.

Bellefontaine, O., may increase thickness in alleys from 6 in. to 7 or 8 in. and in streets from 8 and 6 in. to 9 and 7 in.

Lorain, O., will make concrete 10 in. thick at the center and 6 in. at sides.

Northampton, Pa., is increasing thickness from 7 in. to 8½ in. at the center.

Chehalis, Wash., has increased thickness from 6 in. to 7 in.

Olympia, Wash., has increased thickness on heavy-traffic streets.

Sheboygan, Wis., will increase thickness, which is now 8½ in. at the center and 6 in. at sides.

Wisconsin Rapids, Wis., has increased thickness from 6 and 8 in. to 7 and 8 in.

Mix

Palo Alto, Cal., now uses 6 sacks of cement, 0.51 cu. yd. of sand and 0.81 cu. yd. of rock per cu. yd. of concrete.

Derby, Conn., now uses 1:2:3½ mix.

Kendallville, Ind., two-course pavement, now uses 1:2½:4 for the base and 1:1:1½ for the wearing course.

Newcastle, Ind., two-course pavement, now uses 1:3:5 for the base and 1:1½:3 for wearing course; and for one-course, 1:2:3. 7 in. and 8 in. thick.

Greenfield, Mass., has changed from 1:2:3½ to 1:2:4 and added reinforcement.

Pittsfield, Mass., has decided on 1:2:3½ mix. with reinforcement.

Muskegon, Mich., has changed from 1:2:5 to 1:1½:3.

Greenville, S. C., will use a 1:2½:4 mix.

Wisconsin Rapids, Wis., has changed from 1:2:4 to 1:2:3½

Reinforcement

Edwardsville, Ill. is considering reinforcement.

N. Chicago, Ill., has used 40 lbs. of mesh reinforcement with a 1:2:4 mix. and one-course instead of two, 8 and 6 in. thick, with good results.

Oelwein, Ia., will use mesh reinforcement.

Wichita, Kans., will possibly use reinforcement.

Greenfield, Mass., has adopted reinforcement.

Holyoke, Mass., has adopted reinforcement.

Pittsfield, Mass., has adopted reinforcement.

Worcester, Mass., used reinforcement for the first time in 1921, with a 1:2:4 mix.

Detroit, Minn., has changed weight of reinforcement from 30 lbs. to 40 lbs. per 100 sq. ft.

Webster Grove, Mo., will use 44 lbs. and upward.

Freemont, Neb., will probably use road mesh.

Irvington, N. J., has changed from mesh to bars.

Newton, N. J., has changed from mesh to bars.

Nutley, N. J., will use reinforcement.

Herkimer, N. Y., is trying double fabric reinforcement.

West Park, O., will increase weight from 25 lbs. to 40 lbs. per 100 sq. ft.

Shawnee, Okla., is to use reinforcement.

Altoona, Pa., has increased weight of mesh from 25 lbs. to 56 lbs. per 100 sq. ft.

Monongahela, Pa., will use 40 lb. triangular wire mesh.

Wichita Falls, Tex., is increasing weight to 50 lbs.

Logan, Utah, uses marginal reinforcement instead of 28 lb. wire mesh.

Manitowoc, Wis., is using heavier reinforcement.

Sheboygan, Wis., will increase weight to about 40 lbs.

MISCELLANEOUS.

Centralia, Ill., has adopted concealed joints.

Marion, Ill., will not construct expansion joints but will use a thin metal plate for contraction joint.

Charles City, Ia., will use trap rock instead of gravel as aggregate.

Iowa City, Ia., will use no expansion joints, but fill lateral cracks with filler.

Oelwein, Ia., will use expansion joints.

Baltimore, Md., will permit either gravel or crushed stone in a 1:2:4 mix.

Fairibault, Minn., has increased the amount of crown.

Irvington, N. J., is using corrugated metal strip, 24 gauge, painted, in the center of the road, which is built in two longitudinal sections.

Lackawanna, N. Y., is using crushed slag in place of crushed stone.

Eugene, Ore., expects to use some integral curb.

Lebanon, Pa., has decreased thickness expansion joints to ⅜ in.

Philadelphia, Pa., will lay all concrete pavement, where the soil is clay, on a crushed stone or slag subbase 4 in. thick.

Rutland, Vt., uses larger type of stone dowels at all joints.

West Allis, Wis., has changed from two-course to one-course.

Wisconsin Rapids, Wis., is using separate curb and gutter.

BITUMINOUS CONCRETE

Prescott, Ariz., has changed from 4 in. base to 5 in. base, with no expansion joints.

Burlingame, Ark., has increased the size of rock in Topeka mix.

San Francisco, Cal., is gradually eliminating straight asphalt type and using 1½ in. top on 6 in. cement concrete base.

Pocatello, Ida., is using bitulithic top on 6 in. reinf. concrete base instead of crushed rock base.

Ashland, Ky., is changing from macadam to concrete base.

Clarksdale, Miss., expects to use 6 in. concrete base.

Rutherford, N. J., contempates using asphaltic base.

West New York, N. J., is increasing thickness of base by 1 to 2 inches.

Geneva, N. Y., is increasing thickness of concrete base from 5 in. to 6 in.

OTHER KINDS

Baltimore, Md., has changed mix of cement-sand bed for block paving from 1:4 to 1:3.

Omaha, Neb., has cut out sand cushion for creosoted wood block.

Newark, N. J., uses asphalt and sand filler for granite block instead of cement grout or cement and sand.

Port Chester, N. Y., has increased thickness of base for asphalt block.

MISCELLANEOUS

Tucson, Ariz., is making more extensive use of bituminous base instead of cement concrete where subsoil is caliche.

Anaheim, Ark., is using thicker base and richer mix.

Santa Maria, Cal., has changed from oil macadam to concrete account of freight rates.

Chicago, Ill., has increased base from 6 in. to 8 in., 1:3:6 mix., for heavy traffic streets.

Elwood, Ind., uses heavier designs and better drainage. "Why not a layer of crushed stone under all bases when subsoil is heavy clay or loam?"

Fort Wayne, Ind., has changed concrete base from 1:3:6 mix. to 1:2:4.

Marion, Ind., secures better drainage and thicker foundation.

Creston, Ia., has increased minimum base thickness to not less than 5 in.

Hutchinson, Kans., is using thicker base.

Three Rivers, Mich., now builds combined curb and gutter instead of curb only.

Rochester, Minn., has changed thickness of base from 4 in. to 5 in. and mix. from 1:3:8 to 1:3:6.

Lincoln, Neb., has adopted the use of expansion joints in concrete base.

Buffalo, N. Y., now places reinforcement over all cuts.

Cincinnati, O., now uses 8 in. concrete base on heavy-traffic streets instead of 6 in.

Conneaut, O., is using heavier base.

E. Cleveland, O., has increased the percentage of the large aggregate in the base.

Toledo, O., is increasing the thickness of foundation on heavy-traffic streets.

Oklahoma City, Okla., is using a thicker base, with 5 in. a minimum.

Monongahela, Pa., is using a thicker base.

Pittsburgh, Pa., has increased thickness of base from 6 in. to 8 and 9 in.

Bristol, R. I., is using a heavier base.

Green Bay, Wis., will make combined curb and gutter of one-course construction, using 1:2:3 mix.

Janesville, Wis., is changing concrete base from 5 in. to 6 in. on most work.

Maintenance of Roads

Information on the subject tabulated from reports furnished especially for this issue by highway officials of more than five hundred counties. Mileage maintained, cost of maintenance, where patrol maintenance is used and where gang, equipment of each, work done, etc.

Patrol Maintenance

County and State	Roads on which patrol maintenance is used	Average length of patrol section, miles	Equipment of Patrolman
Alabama			
Montgomery	gravel	20	4 mule, 2 wagoos, rd. mach., etc.
Arkansas			
Hempstead	gravel	12	Grdr, 2 trucks, plow, slip shovels
Colorado			
Elbert	Gravel surf	....	.....
Lake	Between ranches	2	Team & drag
Lincoln	State	40	Truck & drag & light grader
Logan	2,500 mi. co. rds.	....	6 teams, 8 trucks, engine
Delaware			
New Castle	All impr rds.	5	.....
Idaho			
Penewah	State	8.52	2-ton truck, patrol grader
Power	....	5	Drag, fresno, plow, wagon
Illinois			
Bond	Earth	3-6	Drag
Christian	27 mi.	4	Drag, grader & small tools
Clay	Earth	....	Tractors, truck, teams, graders, drags, levelers
De Witt	Co.; starts Apr. 1	25	2 men, tractor & maintainer
Fulton	State aid	8	Grader, drag, small tools
Johnson	Earth	....	.....
Lee	All state aid rds.; gravel, stone & earth	8	Grader, scraper, wagon, small tools
McDonough	Dirt	....	Drag & spade with 2 teams
McHenry	20% of total mileage, main rds.	8.6	Grader & scraper, team & wagon, shovels, etc.
Monroe	State aid rds.	3	Drag & scraper
Pulaski	Gravel rds.	10	Light grader, drag, shovel
Stephenson	200 mi. co. rds.	8	Team, wagon, patrol grader, plow scraper, drag, shovel, spade, axe, bar, hammer
Williamson	State aid	....	.....
Winnebago	Earth	4	Grader, 2 horses, rd. drag, small tools
Woodford	Dirt or oiled earth	30	Truck, drags, maint. machines
Indiana			
Decatur	Macadam	25	Grader, drags, plow, scrapers
Henry	Gravel surf	8	Team, drags, graders.
Jackson	.....	10	Grader, drags, picks & shovels
Posey	.....	25	Drags, scraper, graders, plows, harrows
Shelby	Gravel	12	Drag & grader
St. Joseph	Gravel	16	Grader, drag, small tools
Vigo	All	20	Grader, drag, scraper & plows
Wayne	Gravel	25	Graders, 4 & 2 horse drags

County and State	Roads on which patrol maintenance is used	Average length of patrol section, miles	Equipment of Patrolman
Iowa			
Adair	Earth	10	Plow, slip scraper, buck scraper, grader, small tools
Allamakee	State rds., earth	7½	Grader, drag, plow, scraper, axe, picks, shovel
Benton	Primary & co.	30	Truck, tractor, maintainer, cletrac, wheeler, small grader
Black Hawk	All	10	Small grader, team, wagon, scrap.
Boone	All	10-21	Blade, shovel, picks, spades, scraper, plow, wagon, small tools
Bremer	All prim. & co. rd.	7-10	Grad., plow, shovel, axe, pick & slip
Buena Vista	Primary gravel	6	2 horse grader & misc. tools
Cass	Dirt	6	Drag, slip, plow & hand tools
Cerro Gordo	Earth & gravel	7	Blade, wag., slip, drags, small tls.
Chickasaw	all	6	Truck, team, maint., small tools
Clarke	Earth rds	6	Grader, slip, drag, hand tools
Clay	Gravel	7	Wagon, pat. grader, small tools
Clinton	All	15	Trucks or team, drags, blade, sml. tools
Crawford	Earth	8	Team, wagon, grader, etc.
Dallas	....	20	Maint., tractor, grader, 2 men, small tools
Davis	....	9	Patrol grader, slip, plow
Decatur	Earth	12½	Grader, slips, plow, small tools
Dickinson	All rds.	10	Team, wagon, grader, shovel
Dubuque	Co. & prim. rds.	7	Maint., engine, grader, slip
Floyd	Earth & gravel	team, 5-6; motor, 12-24	Plow, pick, shovel, crowbar, scythe, scraper, wagon, grader
Guthrie	Earth	8	Drag, plow, small tools
Hamilton	Gravel	20	Tractor or truck & maint.
Hancock	Main rds.	15	Grader, slip, wheeler, plow, small tools
Harrison	Dirt	5	Drag, blade, small tools
Jackson	Prim. co.	5-6	Team, patrol, grader, slip, drag, hand tools
Jasper	Earth & gravel	12	Truck, plow, slip, grader, drag, small tools
Kossuth	Dirt & gravel	22½	Drag, engine, maint.
Linn	Earth	10	Plow, slip, drag, grader, small tls.
Lyon	All	5-10	Grader, slip & wheeler
Marshall	Gravel, dirt	18	Drag, grader, small tools
Mitchell	All	5	Scraper, plow, team, wagon, blade grader, small tools
Monona	Earth	8	Tools, blade, slips, plows
Monroe	Earth	8-10	Team, slip, plow, small tools
Montgomery	Dirt	7	Patrol grader, slip & small tools
Muscatine	Cone., grav., earth	20	Tractor, grader, maint., drags, plow, slips

Patrol Maintenance—(Continued)

County and State	Roads on which patrol maintenance is used	Average length patrol section, miles	Equipment of Patrolman
Iowa (Continued):			
Palo Alto	....	12	Slip, scraper, drag, grader, small tools
Pocahontas	Earth & gravel	11	Drag, grader, wagon, small tools
Pottawattamie	Co. & prim.	7	Maint., slip, shovel, axe
Ringgold	Earth	6	Grader, plow, slip, shovel, mower, axe
Sac	150 mi. gravel & graded earth	10	Wagon, drag, grader, small tools
Scott	All	5 pav. 10 earth	Truck or team, shovels, slip
Shelby	Earth	4	Drag, grader, brick, slip, plow
Story	Earth & gravel	12-20	Grader, truck & tractor
Union	Earth	8	4 horse & light maintainer
Wapello	All dirt	8	Drags, light graders
Warren	State & co. system	18	Team, wagon, grader, slip, plow, small tools
Wayne	Dirt	20	Grader, scraper, drag, plow, etc.
Webster	Earth & gravel	15	Truck&maint. or tractor&maint.
Worth	Gravel & earth	10	Grader, plow, slip, etc.
Kansas			
Anderson	Gravel	10	Grader, drag, shovel, pick, hammer, 2 slips, plow
Barton	....	5	Slip, shovel, drag, grader
Bourbon	All paved rds.	....	Truck, grader, scarifier, water tank, pumps, broom
Butler	Dirt	14	Team, wagon, grader, slip, plow, small tools
Clay	Dirt	3	Plow, scraper, drag
Cloud	Dirt	4	Drag
Doniphan	Earth	2½	Drag, plow, scraper
Geary	Dirt	6	Grader, 3 scrapers, plow
Greeley	Earth	6	Drag & shovel
Harvey	....	3-6	Rd. drag & maint.
Jackson	Dirt	12.5	Tractor & team
Kearny	Earth	5	Drag, plow, scraper
Mitchell	Earth	3	Drag, slip, snow drag
Montgomery	Earth	8	Grader, drag, slip, small tools.
Neosho	Gravel	20	Drag, grader, hand tonls
Pawnee	Dirt	4.5	Drag, grader
Republic	Dirt	6	Drag, slip, shovel
Sheridan	Dirt	5	Drag, slip, shovel
Sumner	Earth	3	Drag
Wabaunsee	County	4-5	Drag, scraper
Wichita	Earth	6	Drag, shovel
Kentucky			
Boyle	W. B. mac.	10	Wagon & team, brooms, shovel, truck & grader
Henderson	All	15	Grader, drag, shovel, axes
Owen	W. B. mac., surf treated	8	Light tools, small truck
Shelby	bitum. surf	10	Horse, wagon & hand tools
Trigg	Gravel	9	Team, drag, grader, small tools
Maryland			
Kent	conc. & mac.	3	Grader, drag, tar pot & gravel tools
Michigan			
Alger	Mac. & earth	8	Graders, trucks & drags
Branch	....	15	Truck, grader, drags, plows
Eaton	Gravel	10	grader, drag, shovel, rake, axe
Huron	....	8	Garder, rake, shovel, wagon
Kalkaska	Gravel	6	Wagon, shovels, picks, floats
Lucc	Dirt	6	Wagon, grader, drag, small tools
Macomb	Gravel	7-13	Grader, shovel, etc.
Mecosta	Gravel	12	Team, wagon, grader, small tools
Oakland	Gravel	5	Rd. float & grader
Ontonagon	All	6	Drag, etc.
Minnesota			
Aitkin	....	7	Blade, grader & planer
Blue Earth	Gravel & earth	7-10	Planer, grader, scraper & small tools
Chippewa	Gravel & dirt	5	Grader, mower, slip, wagon
Clay	Earth & gravel	8	Grader, scraper, wagon, mower
Cottonwood	Gravel	7	Grader, drag, wagon, scraper
Crow Wing	....	45	Drag, shovel, rake, etc.
Dakota	Gravel	5	Blade, machine, wagon, shovel, picks, teams
Dodge	Gravel	6-7	Drag , grader, wagon, shovel, rake, mower, etc.
Faribault	Gravel	6	Grader, team, wagon, mower, small tools
Goodhue	Gravel	5-7	Grader, dump wagon, planer, mower
Grant	All	6	Grader, wagon, slip, drag, plow
Hubbard	Earth & gravel	8	Planer, grader, scraper
Isanti	Gravel	8	Grader, drag, hand tools
Jackson	Gravel	7	Grader, scraper, mower, shovel
Kandiyohi	Gravel	5	Blade grader
Lake	State rds.	6	Team, grader, shovel, pick, rake
Lincoln	Gravel	7-8	Team, blade, wagon, plow, slip
Lyon	Gravel	8	Grader, wag., mower, scrap., team
Martin	Dirt & gravel	4	Drag or blade
Meeker	Gravel	6	Grader & small tools
Murray	....	6	Blade grader
Nobles	Earth & gravel	8	Hiway patrol, drag & hand tools
Norman	All	8	Grader, wagon, mower, dump boards, etc.
Ottertail	....	6	Grader, scraper, wagon, drag, mower, hand tools
Pope	Gravel	6	Grader, drag, small tools
Redwood	Gravel	6-8	Grader, wagon, scraper, shovel, pick
Rice	All	5	Grader
Roseau	All	8	Grader, drag, team & wagon
Stearns	State aid	9	Grader, drag, small tools, team
Swift	All	7	Grader, mower, slip, shovel, wag.
Todd	Earth & gravel	6	Drag, grader, small tools
Washington	All state aid rds.	6	Grader, wagon & team, plow, scraper
Watonwan	Gravel	6	Blade, wagon, mower, small tools
Missouri			
Cooper	Earth	Dists.	Earth rd. bldg. machinery
Jasper	....	4	Team, wagon & rd. drag
Washington	20 mi. gravel	2 men to 20 mi.	Truck, small tools
Montana			
Custer	Gravel & dirt	100	Truck, drag
Musselshell	Dirt	8	Team, wagon, drag, pick, shovel
Prairie	All graded rds.	7	Drag, wagon, scraper, pick & shovel
Richland	Dirt	6	Drag & shovel
Sheridan	....	8	Drag, fresno, plow, pick, shovel.
Toole	State hwys.	10	Rd. drags.
Valley	Graded dirt	7	Grader & maint.
Nebraska			
Knox	Earth & gravel	12	3 trucks, 2 teams
Morrill	State rds.	15	Trucks, drags, maint.

Patrol Maintenance—(Continued)

County and State	Roads on which patrol maintenance is used	Average length patrol section, miles	Equipment of Patrolman
New Jersey			
Salem	All	4-6	Scraper
Sussex	W. B. mac.	5	Truck, mixing box, small tools
Union	Macadam	2	Wheelbarrow, hand tools
New York			
Chautauqua	macadam	10	Truck
Niagara	....	5	Horse, wagon, shovel, pick, pouring pot, broom, etc.
Oswego	State	14	Truck, small tools
Schuyler	State & co.	12	Truck
Tompkins	State	5	Truck
Yates	State	12	Truck
North Carolina			
Forsyth	Soil	4	Rd. machine & drag
Graham	State	13	Truck, tractor, scraper, drag
Washington	Sd. clay & top soil	50	Tractor, mules, graders, drags
Yancey	....	10	....
North Dakota			
Barnes	Dirt	....	Truck & drag
Cass	Earth & gravel	60	Tractor, blade & drags
Grand Forks	All	8	Drag, mower, grader
Hettinger	Dirt	20-40	Truck, drags, fresnos
Ward	State gravel rds.	20	Truck, drags
Williams	Earth-conc.	6	Drag, small equip.
Ohio			
Fairfield	220 mi. co. rds.	3-20	Drag, grader, small tools
Hancock	State	....	Truck, tar kettle, grader
Logan	Gravel & stone	4-6	Drag & grader
Ottawa	Macadam	....	Patching only done
Pickaway	Gravel	6	3 teams, 4 men
Pike	Gravel	4	Drag, wagon, team
Oklahoma			
Carter	Gravel & dirt	6	Drag, pick, shovel, slip, wagon. 2 teams
Ellis	Dirt	5	Drag, scraper, 4 horses
Garfield	Dirt	30	Tractor, truck, drag, grader, shovels, etc.
Grady	Co. & state	....	Grader, tractor, fresnoes, conc. mixers
Major	Bridge repair	20	Truck, drag, fresno, wheels, trac.
Oregon			
Grant	Gravel	15	Truck, drag, scrapers, teams, plow, scarifiers, etc.
Marion	Main rds.	6-9	Hoe, rake, shovel, wheelbarrow
Pennsylvania			
Jefferson	Dirt	4	Drags, shovels, picks, rakes
South Carolina			
Aiken	....	12	....
Chesterfield	Gravel & top soil	12	Drag, rd. plow, tractor, truck
Greenwood	All impvd. rds.	16	Truck, kettle, drags, small tools
South Dakota			
Codington	Gravel	10	Blade, wagon, small tools
Custer	Dirt & gravel	7½	Team, drag, grader, small tools
Day	Gravel	9	Team, wagon, blade, mower, slip, small tools
Faulk	Contract	10	Engine, 2 drags
Gregory	Earth	5	8 ft. drag
Haakon	....	6	Plow, slip, grader, drag
Hanson	Gravel	9	Grader & wagon
Jackson	....	10	Drag, maint., fresno
McCook	Gravel	....	....
Meade	Dirt	10	Drag & shovel
Miner	....	35	Small engine & drag
Spink	Earth	12-20	4 horses, drag, scraper, plow
Sully	Earth	....	Engine, maint., small tools
Yankton	Earth	10	Drag, fresno, dump wagons, small tools

County and State	Roads on which patrol maintenance is used	Average length patrol section, miles	Equipment of Patrolman
Tennessee			
Bradley	Rock crushed	....	....
Hamilton	All	10	Horse & wagon, pick, shovel, asph. kettle
Hawkins	Dirt	3	Pick & shovel, dynamite
Montgomery	Gravel	....	Truck
Rutherford	....	16	Shovel, pick & tamper
Texas			
Aransas	All	3 to co.	Two Trucks, graders, etc.
Colorado	Dirt	10	Team, drag
Madison	Earth	10	Tractor, planer & grader
Wichita	Concrete	36	2 trucks, blade, wagon, small tools
Virginia			
Halifax	Soil	6	Team
Scott	Macadam	6	Wheelbarrow, kettle, pick, shovel
Washington			
Asotin	Prim. state hwys.	10	Truck, rd. fixer, small tools
Clallam	Gravel	20	....
Douglas	Gravel	13	Truck & grader
Grant	All surf. rds.	9	Truck or tram, rd. fixer or drag, fresno, rake, pick, shovel
Jefferson	All	25	Truck, graders
Lewis	Grav., hard surf.	15 grav., 20. h.s.	Grader, drag, truck, tractor
Lincoln	Gravel surf. rds.	11	Fixer, drag, grader, tools
Okanogan	Earth	7	Grader, truck, rd. fixer
Pierce	Conc., asph., asph. conc., brick	....	....
Whitman	surf. rds.	10	Team & blades
West Virginia			
Braxton	....	....	Graders, drags, teams
Brooke	Impvd. rds.	3½	Shovel, pick, mattock, wheelbarrows, etc.
Hancock	State	8	Truck, rd. machine, small tools
McDowell	Dirt	....	Rd. machine, scrapers, drags
Monongalia	All	....	Tractor, truck, graders, drags
Polk	Dirt & gravel	8	Grader, fresno, drag, small tools
Upshur	All	conc. 5	Pick
Wisconsin			
Adams	Sand-clay	9	Planer, drag, plow, scrapers, wagon, small tools
Brown	Gravel	8	Truck, teams, motor graders
Buffalo	State & co. rds.	6½	Team, wagon, grader, drag, scraper, plow
Fond du Lac	Co. & state	8½	Team, scraper, plow, slip, drags
Forest	Co. & state	6½	Grader, drag, shovel, pick, rake
Grant	All	8	Grader, drag, plow, scraper, etc.
Jefferson	Clay gravel	8	Team, wagon, drag, grader, pick, shovel, scraper, plow
Juneau	Clay	10	Grader, planer, drag
La Crosse	Macadam	10½	Truck, drag, grader, small tools, tar kettle
Lincoln	Earth & gravel	7¾	Grader, planer, wagon, tools
Monroe	Sand & clay	5.75-7⅞	Horse patrol
Price	State & co.	6½	Teams, grader, wagon
Sawyer	Earth	8	Team, grader, drag, plow, wagon
Vernon	Earth	6.5	Grader, drag, scraper, hand tools
Walworth	Co. & state	8	Grader, wagon, scraper, plow, pick, shovel, etc.
Waukesha	State & co.	8	Grader, dump wagon, small tools
Winnebago	All	8	Grader, wagon, small tools
Wyoming			
Lincoln	State rds.	8 12	Teams, drag, plow, small scraper
Weston	Earth, dragging	20	Truck, drag, small tools

Gang Maintenance

County and State	On What Roads Gang Maintenance is used	Kind of Work Done	Standard Equipment.	Number of men in a gang.
Alabama				
Etowah	Convicts on main rds.	Haul dirt or gravel in holes, clean ditches.	Graders, wagons, tractor, scarifier, picks, shovels, etc.	10-20
Montgomery	gravel	Surf. and ditch work, etc.	.....	3-5
Arkansas				
Hempstead	earth	Clean ditches, shape crown.	Grader, plow, slips, shovels, wagons.	6-12
California				
Fresno	all	Shape earth shoulders and drag gravel rds.	1 man, power graders, truck,	1
Sacramento	conc. & asph. mac.	Fill cracks in conc., patch conc. and asph. mac.	Truck, asph. kettle, pick, shovel, rake, small tools.	3
Sutter	conc. & oil mac.	Gravel shoulders, oil cracks, patch guard rails.	Truck, oil patching, outfit.	3
Colorado				
Chaffee	.....	Grad., drag, fix old culverts, etc.	Horse & wagon, or truck.	2-5
Elbert	.....	Haul gravel, make repairs.	2 men w. truck, hand tools.	2
Lake	all	All repairs.	Truck, pick, shovel.	3-20
Lincoln	state 40 mi.	.....	Truck, drag, light grader.	2
Logan	75 mi. state rd.	Drag, fill up holes, etc.	Teams, truck, engine.	10
Delaware				
New Castle	.....	Repair rds.	.....	..
Idaho				
Clark	only in summer	Regrad. small jobs, gen. rep'rs.	.....	5-10
Shoshone	gravel	Resurf., light grad., drain pipes, etc.	Grader, plow, 2 Fresnos, 2 slips, truck.	4-10
Illinois				
Bond	earth	Grad. and bridge work.	Tractor, grader, maint., con. mixer, scrapers, plow.	3-6
Fulton	earth	.....	Tractor or grader.	4
Knox	dirt	Grade and drag.	Truck, rd. maint.	2
Lee	.....	.....	Grader, Holt Caterpillars.	..
Logan	all	Earth and gravel work.	.....	..
McDonough	dirt	Clean ditches, build shoulders, grade.	Tractor, grader, leveler, teams, small tools.	4
McHenry	.....	Heavy grading.	Engine, heavy grader.	3
Monroe	state aid	Clean and grade earth rds.	Grader, tractor, 4 scrapers.	6
Pratt	earth	Grade and run tractor.	Tractor, grader, leveler.	2
Scott	state aid	Grade and machine maint.	Tractor, grader, back sloper, leveler.	2
Stephenson	all co. rds.	Patrol and haul. gravel, open ditches, clean culvts., cut brush	Tractor, blade grader.	2
Woodford	.....	Clean culvts., mow weeds, apply rd. oil.	Truck oiler, drags.	4
Indiana				
Dubois	105 mi. mac.	Open side ditches, fill holes, rough repair.	Truck w. shovels, grader, etc.	..
Hancock	.....	Grade and drag.	Graders, drags.	2-6
Henry	.....	Grade repair. & reconst. side drains.	Trucks, plows, graders, tractor, engine.	..
Madison	all	Everything.	Graders, drags, shovels, brushes, etc.	..
Posey	all	Repair.	.....	..
Shelby	.....	Haul, material.	Wagon and team.	..
St. Joseph	grav., conc., asph.	All but grade & spread mate.	Trucks, tractor, grader, gravel screen., plant, drag, small tools.	2-25
Vigo	heavy repairs	Grade, resurf., conc. repair	.....	..
Wayne	.....	Hauling gravel.	Trucks, loader, cable dip. outfit.	8
Iowa:				
Adair	earth	Fills at bridges & culvts., grades in low places.	Scrapers, graders, rd. planers, 8 teams.	10
Allamahee	earth	.....	Tractor, grader, plow, scrapers.	4-12
Benton	co. & primary	Raise low places, blade grade.	Tractor, 2 graders, Ford tractor, wheeler.	2-4
Black Hawk	earth & gravel	Ditch. and smooth.	Grader & tractor.	..
Boone	.....	Grade and gravel.	Tractors, blade.	3
Bremer	.....	Blade grading	.....	3
Buena Vista	all	Heavy blade grad., maint. grav.	Tractor & blade.	..
Cass	dirt	.....	Grader, tractor.	2
Cerro Gordo	concrete	Tar cracks, repair shoulders.	Tar heater, truck, wagon, small tools.	4
Chickasaw	.....	.....	Tractor, blader.	2-6
Clark	blade grader wk.	Dig ditches, dirt on crown of rd.	Tractor, grader, slips, plow, team.	3
Clay	gravel	Resurf., reshape dirt rds.	10-ton Holt, 12-ft. blade for reshaping.	3
Clinton	earth	Emergency.	Teams and wheelers or slips.	..
Crawford	earth	All sorts.	Motor truck.	5-6
Dallas	mostly earth	Make sm. fills on rds & culvts.	Plow, wheelers, slips, sm. tools.	2-6
Davis	dirt	Heavy blade grad.	Tractor, grader.	2
Decatur	earth	Widen, grade, make large fills.	Grader, Fresnos, wheelers, slips.	7-12
Dickinson	all	Tiling and major repairs.	.....	..
Dubuque	earth, gravel	Ditch work, resurf., etc.	Wheelers, slips, trucks, sm. tools.	5-10
Floyd	earth, grav., pavt.	Fill cracks, repair should., clean right way.	Tar kettle, buckets, wheelers, slips, truck.	3-6
Guthrie	earth	Build up grades, clean ditches.	Elev. grader, wagons, plows, scrapers.	12
Hamilton	all	Smooth.	Tractor & graders.	3
Hancock	dirt	Grade.	10-ton Tractor, blade grader.	3
Harrison	heavy maint.	.....	Engine, grader.	2-6
Jackson	all	.....	Tractor, grader, rd. planer, team.	4
Jasper	earth	.....	Tractor, grader, sllo, plow, team.	3
Linn	earth	Repair.	Wheeler scrapers, plows, scrapers.	8
Lyon	all	Trim & ditch all co. rds.	Holt, blade grad., drag.	2
Marshall	dirt	Tractor grad. & team work.	.....	..
Mitchell	earth, gravel	Fills, tiling, blade grader wk.	Tractor, blades.	..
Monona	earth	Temporary grading.	Tractor, maintainer, blade.	2-3
Montgomery	dirt; heavy rep.	Gen. repairs & earth rd.	Maint., blade graders.	6
Muscatine	earth	Regrade rds.	Tractor, grader, team, slip, wag.	3
Pocahontas	gravel	Shape grade for surf. or resurf.	Blade, grader, trucks.	2-7
Pottawattamie	co. & prim. rds.	Engine grader wk., fill bridges and culvts.	Engine graders, wheel scrapers.	3-20
Ringgold	.....	Blade grading.	Tractor, Grader.	2

Gang Maintance—continued

County and State	On What Roads Gang Maintenance is used	Kind of Work Done	Standard Equipment	Number of men in a gang
Iowa (Continued):				
Sac	grav. & grad. earth in sum.	Reshoulder, reditch, recrown, haul gravel.	Tractor, blade grader, trucks.	2-5
Scott	earth & grav.	Resurf., blade grader wk., rip rap, oiling.	2 Trucks, tractor, grader, roller, oilers, slips, wheelers, shovels.	6-10
Shelby	earth	All heavy grader work.	.....	..
Story	earth & grav.	Grade and gravel surf.	Tractor, grader.	2
Union	earth	Heavy grader and wheelers.	Varies.	3-10
Wapello	dirt	Grade.	2 Tractors, grader, maintenance.	4
Warren	state & co.	Blade grader.	Tractor, grader, wagons, small tools.	2
Wayne	dirt	Ditch line work.	Wheel, scrapers, drag scrapers	6
Webster	.....	Resurf. and reshape.	Mostly by contract.	..
Worth	gravel & earth	Heavy repair work.	Wheelers, plow, slips, etc.	7-8
Kansas:				
Anderson	dirt	Drainage open, repair grade.	3 wheelers, 4 slips, plow.	10-15
Barton	concrete	Shoulder work & fill, cracks.	.....	2-4
Bourbon	all paved rds.	Surf., shoulder, mow, weed, patch.	Truck, tools, grad., scarifier, water tank, etc.	2
Clay	dirt	Blade grader wk., fills, etc.	Tractor, grader, maint.	..
Doniphan	earth	Cuts & fills, reduce grades.	Plow, drag, 3 or 4 scrapers.	4-5
Geary	hard surf. rds.	Shoulder, clean, ditches, rep. cul.	Shovels, conc. mixer, slips, drags, wheelbarrows.	2-5
Harvey	dirt	Slip work, dragging.	Scraper, drag, maint.	1-4
Jackson	.....	Care rd. bed, except grad.	Shovels, picks, bars, sledge, rd. drag.	2
Mitchell	earth	Grade, fill, etc.	Tractor, graders, Fresnos, slips.	..
Montgomery	.....	Engine grader work.	Tractor, large grader.	4
Neosho	dirt	Clean, grub, clean ditches, etc.	Slips, Fresnos, grader, planer, hand tools.	6
Pawnee	dirt	Grade & surface.	Grader, 5 Fresnos, plow, roller, harrow.	12
Republic	on 13 mi.	Drag & grade.	2 Trucks, 2 heavy drags, grader, slips.	2
Sheridan	dirt	.....	.....	5-8
Sumner	earth	All slip work.	Plows, slips, Fresnos, team.	6-10
Wabaunsee	county	Grade & ditch with rd. graders.	Tractor, grader, scrapers, plow.	3-8
Kentucky:				
Boyle	.....	Patch., ditch., bldg. shoulders.	Truck, team, grader, small tools.	2-10
Daviess	gravel & earth	Grade earth rds., ditch, patch, gravel.	Plows, grader, 6 mules, wagon.	5-10
Hancock	earth	Grade, drain, repair culvts, etc.	Truck, grader, drag, plow, scrapers, picks, shovels.	10
Owen	.....	Resurf. work; broken stone.	Truck; broken stone; roller, etc.	5-10
Shelby	W. B. mac.	Ditch & Patch with stone.	Roller, tractor, grader, 2 trucks, hand tools.	12
Whitley	.....	Clean ditches & move slides.	Tractor, rd. grader.	6-10
Louisiana:				
Allen	gravel	Spread grav., drag rds., clean ditches.	None.	5
Maryland:				
Kent	macadam	Patch. mac. & shoulder work.	Trucks, grader, drags, steam roller, tar pots, small tools.	12-15
Michigan:				
Alger	mac. & earth	Hauling material.	Truck & Tractors.	4
Branch	state	Drag., patch., resurf., plow & ditch.	Truck, grader, drags.	4
Eaton	gravel	Ditch, scarifying.	Tractor, scarifier, small tools.	5-10
Huron	imp. & unimp. rds.	Grade on unimp.; guard rail, culverts, tarring.	Tar kettle, large grader, truck.	3-5
Kalkaska	gravel	Resurfacing.	Horses & wagons, screens, shov.	10
Luce	hard surf.	Scarifying, reshape, surf. treat.	Trucks, trailers, distributor, small tools.	8
Macomb	conc. or bit. surf.	Patch, tar, clean ditches, repair culvts., guard rail, cut weeds.	Tar kettle, truck, tools.	2-10
Mecosta	.....	Stock piles, patches, guard rails, culvts., brush.	Truck, shovels, axes, scythes.	2-4
Oakland	conc. & asph.	Patch, tar, cut. weeds, etc.	Truck, tar kettle, heat. furnace, mowing mach. small tools.	6
Ontonagon	.....	Heavy wk., resurf., etc.	Grader, truck, misc. equip.	6-12
Minnesota				
Aitkin		Clear, raising grade	Blade grade & planer	8
Cottonwood	dirt	Reshape w. graders	2 graders, tractor	4
Crow Wing	earth	Reshaping	Grader	5
Faribault	earth	Drags, clean ditches, culverts, bridge repairs	Tractor, drags, blade grader, small tools	...
Goodhue	.....	Reshaping rds.	40-60 tractor, blade grader	...
Hubbard	.....	Reshaping rds.	Tractor, large blade grader	3-4
Isanti	gravel & earth	Regravel small jobs, small fills	.....	...
Lake	state rds.	Gen. repairs	1-2 motor trucks, small tools	2-6
Lincoln	.....	Light regraveling & grading	Wagons & equip., blade, wheelers	4-12
Lyon	gravel	Resurf. by contract	Trucks and loading equip.	...
Martin	gravel & dirt	Light blading, gravel resurf.	Lt. tractor & blade or lt. truck	2
Meeker	gravel	Resurf. & widen	Gravel wagons, fresno & slips	4-40
Murray	.....	Regravel & reshape	Trucks—Tractor & blade grader w. back sloper	...
Norman	.....	Heavy reshaping	35-70 tractor and grader	3
Ottertail	floating gang	Gravel & clay resurf. & widen grade	7 trucks, loading devices, 6 scrapers	16
Redwood	gravel	Reshape & regravel	Caterpillar tractor, blade grader, 3 trucks	3-4
Rice	.....	Regravel	8 trucks	15
Roseau	.....	Heavy reshaping	Large grader	3-4
Stearns	trunk	Grade & surface	Tractor, grader, trucks	10-15
Swift	dirt	Reshaping	40 H. P. tractor, blade, teams, etc.	3
Todd	earth	Heavy reshaping & blade work	Tractor, blade, wagons, slips, wheelers	10
Mississippi				
Noxubee	gravel, sand-clay	Gravel resurf., open ditches, etc.	Rd. mach., scrapers, shovels, trucks	3-10

Gang Maintance—continued

County and State	On What Roads Gang Maintenance is used	Kind of Work Done	Standard Equipment	Number of men in a gang
Missouri				
Butler	county	Gen. rd. & bridge repairs	.....	...
Mississippi	all	Gen. rd. & bridge repairs	.....	3-10
Ralls	mostly all earth	Shape, ditch, smooth	Tractor, grader, plows	4
Washington	.....	Gravel, open ditch, gen. repair	Truck, small tools	2
Montana				
Granite	earth	Patching & bridge repair	None	...
Musselshell	dirt	Emergency	.....	...
Nebraska				
Morrill	dirt & gravel	.....	Truck maint. & drags	2
New Jersey				
Sussex	W. B. mac.	Rebuild worn-out stretches	Trucks, roller w. scarifier, scraper, wagons, small tools	18
Union	all but mac.	Repair	Trucks, steam rollers, tractors	3-10
New York				
Cayuga	state	Clean shoulders, repair depressions, resurf.	Truck, oil heater, minor tools	3 up
Chautauqua	concrete	Patch	Truck, small tools	2
Niagara	all	Clean ditches, repair shoulders, patch, oil	Trucks, roller, 2 heaters, sweeper, oiler, 6 brooms	6-20
Oswego	state	Reconst., heavy drainage	Trucks, asph. heaters, graders, tractors, small tools	5-15
Schenectady	state	Surf. maint.	Motor truck, asph. heater, tools	3-8
Tompkins	earth	Repairs	Cold patch outfit	8
Yates	bituminous	Fill depressions, asph. surf. treat.	Cold patch & mixing method	4-12
North Carolina				
Bertie	soil	.....	Rd. mach. carts, tractors, trucks, wagons, small tools	6
Forsyth	soil & tarvia pen.	all kinds	.....	..
Graham	dirt	Put in culvts., stone & gravel	Tractor, scrapers, drags	6
Washington	all	Drag, grade, drain, brush	Graders, maintainers, drags	6-15
Wilson	top soil	New const.	Mules, scrapers, drags, picks, shovels	25
North Dakota				
Hettinger	common clay	.....	Trucks, drags, fresnos	3
Ward	earth (not grad.)	Grade worst places	14-20 horses and fresnos, blade and engine	3-8
Ohio				
Ashland	entire co.	Repairs	Truck, conc. mixer, shovels, picks	6
Ashtabula	all impr. rds.	Ditch, cut weeds & brush, repair surf.	Truck, grader, wheelbar., shovels	5
Fairfield	50 mi.	Everything but bridge work	6 trucks, graders, etc.	..
Fulton	co. & state	Repair surf. & reconst.	Steam roller, trucks, graders	..
Hancock	macadam	Grade, reshape & roll	Roller, scarifier, scraper	3
Hardin	state	Repair surf. & drains	.....	3-5
Holmes	state & co.	Patch, reshape & grade	Maint., teams, plows, shovels, scrapers	4-10
Meigs	.....	.....	Road maint.	8
Mercer	state	Repair surf. cracks & joints, ditch	Truck, tar kettle, tools	5-6
Ottawa	.....	.....	Brooms, truck, tar kettle	4
Pickaway	gravel	Shovel gravel, patch holes, clean ditches	Grader, 2 drags, shovels, rakes, screens, tar kettle	5
Pike	state	Repair & drag	Truck, drag, tools	8
Putnam	W. B. mac.	Patch with tar & stone	Truck, shovels	6
Sandusky	state	Patch, bitum. rds., repair conc.	Auto, trucks, conc. mixer, mower, grader	4-10
Shelby	.....	Drag, scrape, cut side ditches, haul materials	Drags, scrapers, trucks, teams	4-35
Williams	mac. & bit. mac.	Patch, haul materials, ditch, spread covering	4 Nash quads, truck, sweeper, grad., picks, shovels, brooms, etc.	8-25
Oklahoma				
Carter	gravel	Main. & repair, rd. bed & surf.	Trucks, grader, etc.	2-10
Ellis	dirt	Regrade	Grader, 12 mules, 3 fresnos	7
Grady	county	Repair work	None	..
Major	repair	Bridge & culvt., repair, grading	4 mules, fresno, plow, 6 shovels, wagon, grader	4
Oregon				
Grant	dirt	Repairs on washouts, grade & smooth. with graders	Roller, plow, grader, 3 fresnos, 2 slips, wagon	4-12
Pennsylvania				
Delaware	tarvia	Repair & rebuilding	Picks, shovels, drills, etc.	15-20
Erie	dirt	Grade & gravel	.....	3-8
Jefferson	dirt	Surf. & ditching	Picks, shovels, scraper, teams	6-8
Lackawanna	asph. conc.	Repair small surf. breaks	Asph. tank & stone truck	6
Monroe	dirt & shale	Open ditches & repair rd.	Rd. mach., drags, hand tools	..
Warren	all	Gen. repairs conc. & grad. earth	Varies	..
South Carolina				
Aiken	sand-clay	.....	Truck, rd. mach.	6
Anderson	top soil	Machining up rds.	Tractors, rd. machinery	7-10
Cherokee	mac. top soil	Resurf., repair, etc.	Mach. or graders, scrapers, trucks, tractors, mules	4-8
Greenwood	.....	Scarifiying, heavy mach. resurf.	Tractor, clectrac, 4 rd. mach., 2 scarifiers, plows, small tools	10
South Dakota:				
Clay	dirt	Drag & repair	Tractor, drag, maint.	2
Custer	dirt & gravel	Remodel crowns, widen curves	Grader & 4 horses, plow, fresno	3
Day	.....	Repairs holes & washouts	Truck, small tools	4
Douglas	dirt	Fill holes, etc.	Plow, scrapers, drag	2-6
Gregory	in spring	Maint. with engines and blades	Holt, 3 blades, maint.	2-5
Haakon	.....	.....	Engine, maint.	2
Meade	bridge	Place cul., grade had washouts	fresno, plow, teams, eng. maint.	2
Miner	clay & gravel	Fill chuck holes, washouts & mow weeds	.....	..
Spink	.....	Gen. maint. & keeping up rd.	Engine, blade grader, rd. finisher, small tools	2
Tennessee:				
Bradley	gravel & rock	Grade, roll, haul gravel, etc.	Roller, 6 graders, steam engine, 2 tractors	8
Cocke	pike	Scatter crushed rock	Crusher outfit, wagons, teams	10
Cumberland	.....	General repairs	.....	..
Grundy	earth	Drag & drain	Hand tools & drag	10
Hamilton	all near camp	Ditch & repairs to surf.	Truck, asph. kettle, picks, shovels	7
Hawkins	graded rd.	General repair work	Tractor, grader, trucks, slips, etc.	5
Jefferson	mac.	Crush rock, fill holes, open ditches	Rock crusher, trucks, steam drill, etc.	20
Lewis	grad & chert surf.	.....	Truck grader, small tools	4
Montgomery	.....	Haul gravel & stone	Trucks	3-5
Rutherford	federal aid	Look after shoulders & ditches	.....	1

Gang Maintance—continued

County and State	On What Roads Gang Maintenance is used	Kind of Work Done	Standard Equipment	Number of men in a gang
Texas:				
Aransas	.....	Emergency	.....	..
Colorado	.....	Keep bad holes passable	8 mules, 2 wagons, grader, plow, fresno	2
Comanche	.....	Blades shoulders & surf., repair bridges	Tractor, grader, wagon, team, tools	4
Smith	all	Replace shoulder material & keep ditches & should. in shape	4 teams, 2 trucks, portable camps	10
Tarrant	all	General maintenance	Picks, shovels, rakes, trucks	..
Wichita	dirt	Maintenance	Tractor, heavy blade, drags	8
Wise	all	Grade, drag, repair structures & patch gravel rds.	2 graders, drag, mules, fresnos, shovels	1-10
Virginia:				
Angusta	earth & mac.	Surf. treat., patch & gen'l. rep.	Truck, patch, outfit, hand tools, teams, scrapers, drag	..
Fairfax	all	Patch, ditch, resurf.	Truck, wheelbarrow, hand tools, rd. machine, teams, etc.	5-10
Halifax	all	General repair	Rd. mach. & small tools	10-12
Scott	soil	Drag, rd. mach., ditching	Truck, tractor, drag, rd. mach., scrapers, picks, shovels	..
Washington:				
Asotin	.....	Maint. & const. small jobs	Grader, tractor or truck, small tools	..
Grant	earth in spring	Repair washouts	Grader, drag, fresnos, shovels, plow, etc.	4
Grays Harbor	gravel	Drag	Truck, blade grader	2
Island	.....	Grade, drag, gravel, ditch., etc.	Truck tractor, grader, drag	5
Lincoln	gravel & mac.	Resurf. with crushed material	Rock crushers, screens, scraper, trucks, scarifier, graders, drag	10-14
Okanogan	.....	Keep ditches & culvts. open, repair surf., drag	.....	1-6
Pierce	paved & gravel	.....	.....	3-10
San Juan	earth & gravel	Deepen ditches, drag new grav.	Trucks, tractor, graders, drags, small tools	2-3
Snohomish	all	Ditches, shoulder, gravel surf., brush	Power loaders, trucks, scarifiers, tractors, drags, rd. level.	10
Whitman	state rds.	clean ditches, distributes maint.	.....	3-10
West Virginia:				
Brooke	all kinds	Drain, surf., repair, etc.	Truck, tools, grader, tractor, tar kettle	7
Hancock	dist. rds.	Ditch, surf., culvts., etc.	Rd. machine, plows, slip scraper, tools, etc.	3-8
McDowell	.....	Repair dirt roads	Rd. mach., scrapers, drags, etc.	10-15
Mineral	earth & bitum.	Oil bitum., surf., clean ditches	Oiler, rd. mach., truck	3-8
Monongalia	hard surf. rds.	Ditch, burn & tar seams, etc.	Truck, tar kettle	10-15
Polk	.....	Heavy grading, light const.	Tractor, grader, fresnos, plow	6
Wyoming	all	Drag, fill in low places, etc.	Tractor, rd. mach., pick, shovel	4-8
Wisconsin:				
Adams	sand	Haul clay for surf.	Grader, plow & wagons	12
Brown	.....	Mostly widening rds.	Tractor, graders	6-10
Buffalo	all not imprv.	Large grader & fresno scraper	Tractor and grader	2
Fond du Lac	to assist regular patrol	Widen & ditch.	Tractor, large grader, plows & scrapers	..
Forest	earth rds.; spring	Heavy maint., culvts, ditches	Tractor, grader, wheelers, plows	12
Grant	earth & mac.	Oiling & heavy grad.	Tractor, grader, 2 teams with wheel scrapers	6
Jefferson	state & co. trunk lines	Grading; some surf.	Tractor, grader, scarifier	2
Juneau	clay & sand	Grading	Slushers, wheelers	8
La Crosse	dirt	Grading & cutting ditches	Tractor, grader, wheeler, air compressor, tools	6
Lincoln	earth	Regrading	Tractor, grader, 3 teams	5
Monroe	gen. work	Grading	Tractors, graders	8
Price	state trunk line	Regrading & graveling	Graders, teams & wagons	10
Sawyer	.....	Widen & ditch fill	Tractors, graders, teams, wheeler fresno, slips	10
Vernon	earth	Heavy grading	Tractor, grader, scrapers, small tools	4-12
Walworth	.....	Gravel grading, ditching	Trucks, grader, wheelers, plow, etc.	12
Waukesha	dirt	Grade & surf. with crushed grav.	Tractor, grader, port. crushing plant, trucks	10-15
Winnebago	gravel & mac.	Scarify & level	Gas. roller & combined scarifier & grader	2

Cost of Maintenance

County and State	Mileage Under Maintenance	Amount spent for maintenance in 1921	Amount available for maintenance in 1922
Alabama:			
Etowah	1,100 unimp., grad., gravel, chert, surf. treat.	$43,829	$40,000
Montgomery	450	200,000	200,000
Arkansas:			
Hempstead	64 gravel.	6,600	7,500
California:			
Fresno	60 paved and 100 mt.	20,000	100,000
Plumas	500	60,000	90,000
Sacramento	130 conc., 100 asph. mac., 1,600 dirt.	200,000	200,000
Sutter	8.5 con., 40 oil mac.	3,000	60,000
Colorado:			
Elbert	.....	.....	20,000
Lake	64.5 gravel.	8,000	10,000
Lincoln	Scattered.	.....	22,000
Logan	800 cn. and state.	20,000	20,000
Delaware:			
New Castle	962 various.	363,000	.....
Idaho:			
Clark	Not classified.	10,000	10,000
Power	52 gravel, 148 earth.	17,000	15,000
Shoshone	60 regular and 60 part time.	53,500	30,000
Illinois:			
Bond	None.	.....	20,000
Christian	27	3,100	5,000
De Witt	None.	.....	38,000
Fulton	150	18,000	70,000
Iroquois	None.	.....	43,000
Johnson	By arrangement with rd. com.	30,000	44,000
Knox	160 oiled rds.		
Lee	53 stone or gravel, 107 earth.	150,000 18,000	70,000 75,000

Cost of Maintenance (Continued)

County and State	Mileage Under Maintenance	Amount spent for maintenance in 1921	Amount available for maintenance in 1922
Illinois (Continued):			
Logan	94	10,000	15,000
Marion	15 earth.	1,200	3,700
McDonough	500	100*	150*
McHenry	.....	191,000	44,000
Monroe	None.	None	10,000
Pope	None.	.....	1,000†
Pratt	200 oiled.	15,000	20,000
Pulaski	30, mostly gravel.	3,000	8,500
Scott	None	.....	58,482
Stephenson	5 state rds.	.....	160,000
Williamson	.....	77,850	80,000
Winnebago	8	1,073	1,472
Woodford	30 oiled earth.	13,000	50,000
Indiana:			
Decatur	400 macadam.	100,000	100,000
Dubois	95	14,500	15,000
Hancock	500 all types.	50,000	40,000
Henry	385 gravel.	78,000	80,000
Jackson	550	55,000	70,000
Jasper	300 stone and gravel.	47,000	50,000
Jennings	280 gravel and stone.	28,000	40,000
Madison	1,000, 50 surf.	100,000	130,000
Morgan	400 gravel and crushed stone.	25,000	28,000
Posey	325 gravel.	80,000	63,000
Shelby	420 gravel, stone, conc.	70,000	70,000
St. Joseph	117⅝ gravel, 30⅝ conc., 5¾ asph. mac.	90,000	85,000
Vermillion	15 hard rds., 405 gravel.	65,600	71,000
Vigo	525 gravel, stone, brk., asph. and conc.	175,000	50,000
Wayne	450	50,000	50,000
Iowa:			
Adair	60 earth.	14,000	16,000
Allamahee	85 earth by state, 95 by county.	64,000	58,000
Benton	242 county and prim.	80,000	74,000
Black Hawk	185 earth, incl. 15 gravel.	64,000	57,000
Boone	185	36,000	40,000
Bremer	130	37,000	34,000
Buena Vista	158 gravel, 17 earth.	60,000	50,000
Cass	160 dirt.	40,000	50,000
Cerro Gordo	36 conc. 125 earth.	28,000	35,000
Chickasaw	146	39,000	40,000
Clark	12.6 earth.	39,000	36,000
Clay	34 earth, 121 gravel, 27 resurf.	36,900	40,000
Clinton	190 earth and gravel.	42,000	60,000
Crawford	158	80,000	60,000
Dallas	92 co., 87 prim., 920 twp.	97,500	100,000
Davis	53 dirt.	6,116	40,000
Decatur	Earth.	44,363	45,000
Dickinson	142 gravel.	50,000	35,000
Dubuque	40 gravel, 3.5 pav., 130 earth.	60,000	60,000
Floyd	Gravel $185 per mi.	34,578	25,000
Guthrie	200 earth.	50,000	50,000
Hamilton	125 gravel, 125 earth.	45,000	40,000
Hancock	10 pav., 30 gravel, 110 dirt.	20,000	20,000
Harrison	170 earth.	300*	50,000
Jackson	162 earth.	35,000	40,000
Jasper	225 earth and gravel.	62,000	62,000
Kossuth	180	60,000	60,000
Linn	100 prim., 112 county.	80,000	80,000
Lyon	31 gravel, 157 earth.	20,000	25,000
Marshall	61 pav., 12 gravel, 182 dirt.	45,000	36,000
Mitchell	16 gravel, 45 earth to grade, 80 temp.	40,000	55,000
Monona	165 earth.	33,929	37,000
Montgomery	150 dirt.	50 000	50,000
Muscatine	41 conc., 4.15 gravel, 151.5 earth.	36,271	84,000
Palo Alto	2 pav., 12 gravel, 102 earth.	21,300	20,000
Pocahontas	141 gravel, 36 earth.	50,589	65,000
Pottawattomie	302	70,000	125,000
Ringgold	200	40,000	30,000
Sac	110 gravel, 40 graded earth.	62,000	60,000
Scott	17 brk. pav., 30 mac., 115 dirt.	36,658	53,000
Shelby	153.6 earth.	63,641	Same
Story	100 earth, 100 gravel.	90,000	35,000
Union	154 earth.	28,000	Same
Wapello	150 dirt.	34,000	50,000
Warren	178 earth.	44,383	50,000
Wayne	180	25,000	50,000
Webster	55 gravel, 132 earth.	71,600	60,000
Worth	116	21,700	28,000
Kansas:			
Anderson	149 earth.	6,228	7,000
Barton	3 conc., 230 dirt (co.), 560 (twn.).	20,154	25,000
Bourbon	45 W. B., 12 W. B. and bitum. surf.	.....	.....
Butler	240 dirt.	70,000	75,000
Clay	190 dirt.	27,800	26,000
Cloud	202 dirt.	7,813	14,000
Doniphan	532 earth.	76,373	.....
Finney	300 earth.	7,500	9,000
Geary	2.5 brk., 8 conc., 95.75 earth co., 44.216 earth twp.	60,802	60,000
Greeley	78 earth.	570	650
Harvey	729 dirt.	81,224	90,000
Jackson	69	7,210	11,250
Kearny	66 co., 40 twp.	2,733	10,000
Mitchell	212 earth.	26,402	23,000
Montgomery	Each and gravel.	40,000	42,000
Neosho	.....	.....	8,500
Pawnee	139 dirt, 2 gravel, 3 sand-clay.	7,856	12,365
Republic	206 earth.	12,000	12,000
Sheridan	175	5,000	5,000
Sumner	553.4 earth.	29,455	.....
Wabaunsee	180 dirt.	12,000	12,000
Wichita	68 dirt.	672	800
Kentucky:			
Hancock	400 earth, 10 gravel.	16,000	16,000
Henderson	555 earth, 95½ gravel.	54,450	75,000
Owen	.....	.....	25,000
Rockcastle	4 macadam.	2,500	6,000
Shelby	480	71,000	5,000
Whitley	65	5,200	3,200
Louisiana:			
Allen	.....	....	50,000
Maryland:			
Kent	20 cem., 10 mac., 10 grav.	....	270,000
Michigan:		61,204	65,000
Alger	40 mac., 80 earth.		
Branch	47 conc. & gravel, state, 150 gravel, co.	30,688	30,000
Eaton	200	90,594	70,000
Huron	10 conc., 230 gravel.	85,000	70,000
Kalkaska	55	10,500	10,000
Luce	50 hard surf., 20 dirt	18,000	35,000
Macomb	226 gravel, slag grav., conc., asph. conc.	105,000	100,000
Mecosta	126 gravel.	26,000	26,000
Oakland	290 gravel, 70 conc.	282,487	300,000
Ontonagon	150	51,000	56,000
Minnesota:			
Aitkin	189 dirt & gravel	....	20,000
Blue Earth	150 gravel & earth.	39,220	40,000
Chippewa	67 gravel & dirt	12,023	12,000
Clay	108 earth & gravel.	27,224	25,000
Cottonwood	Gravel and dirt.	32,000	12,000
Crow Wing	92.7 trunk hwy., $2.5 state, 154 co.	20,246	19,050
Dakota	257.8 dirt & gravel	31,924	Same
Dodge	60 dirt & gravel	13,515	12,000
Faribault	.....	17,000	35,000
Goodhue	130	50,000	50,000
Grant	50 earth, 20 gravel	10,212	10,000
Hubbard	146	20,000	20,000
Isanti	80, 40 grav., surf.	8,788	10,000
Jackson	35 gravel, 3 dirt.	23,000	18,000
Kandiyohi	50	5,000	10,000
Lake	85 state & co.	6,495	6,000
Lincoln	30 dirt, 30 gravel.	5,618	6,000
Lyon	177.6 to June 1.	19,029	25,000
Martin	28 gravel, 108 dirt.	30,873	30,000
Meeker	200 gravel	60,000	50,000
Murray	50 dirt, 25 gravel; 34 gravel by state	20,713	20,000
Nobles	160 earth & gravel	23,475	35,000
Norman	150	42,000	50,000
Ottertail	450 dirt & grav. surf.	75,000	Same
Pope	150	....	10,000
Redwood	130 grav., 8 dirt.	58,000	45,000
Rice	290.8 state, 70.68 trunk hwy.; 13 pav., rest grav.	30,245	Same
Roseau	180 earth & grav., surf.	18,000	Same
Stearns	364	70,000	70,000
Swift	22 gravel, 51 dirt	28,000	25,000
Todd	165 petrol. & grader maint.	25,600	31,000
Washington	40 gravel, 46 dirt	22,000	20,000
Watonwan	20 gravel, 76 dirt	12,000	12,000
Missouri:			
Butler	600	20,000	20,000
Cooper	.....	.....	50,000
Jasper	.....	6,500	8,000
Linn	1000	20,000	Same
Mississippi	500 earth.	20,000	25,000
Rolls	50 earth.	4,000	5,000
Stoddard	.....	20,000	30,000
Washington	.....	2,000	....
Montana:			
Custer	419.60 gravel & dirt graded rds., 429 dirt, $20,000	5,000	46,000
Deer Lodge	300	51,650	None
Granite	200	12,000	10,000
Mussel Shell	1103.1 dirt.	33,500	25,000
Prairie	240	2,200	as need'd

Cost of Maintenance (Continued)

County and State	Mileage Under Maintenance	Amount spent for maintenance in 1921	Amount available for maintenance in 1922
Montana (Continued)			
Richland	1296—212 graded, 100 maint. w. drags.	6,655	5,000
Sheridan	90 earth	3,500	4,000
Valley	250 grad. dirt.	15,600	12,500
Nebraska:			
Knox	65 earth	30,000	40,000
Morrill	40	2,000	2,000
New Jersey:			
Salem	100	40,000	50,000
Sussex	45 W. B. mac., 15 grav.	96,000	100,000
Union	68—80% conc. or other hard surf.	175,000	175,000
New York:			
Cayuga	69 oil & stone chips, 1¼ resurf.	50,000	45,000
Chautauqua	180 mac. & conc.	120,000	120,000
Niagara	450 mac. oiled & patched conc. & brk. cracks poured, shoulders	200,000	200,000
Oswego	State 160, co., 140	135,000	140,000
Schenectady	90	....	94,000
Tompkins	131	130,000	....
Yates	50	53,000	50,000
No. Carolina:			
Bertie	500	45,000	Same
Forsyth	30 hard surf., 170 top soil	15,000	25,000
Graham	114 dirt	22,000	15,000
Washington	175	50,000	25,000
Wilson	20 old mac., 480 gravel & top soil	25,000	25,000
Yancey	200	30,000	....
No. Dakota:			
Barnes	120 dirt.	10,500	15,000
Cass	300 earth, 5 gravel.	30,000	30,000
Grand Forks	140 dirt & gravel.	7,434	17,072
Grant	300	5,000	5,000
Hettinger	200-300	4,000	6,000
Ward	200	20,000	26,000
Williams	200 earth	....	....
Ohio:			
Ashland	Brick, mac., gravel.	90,000	90,000
Ashtabula	25 conc., 25 cinder, 60 bit. mac., 65 brk.	105,000	145,000
Fairfield	220	120,000	150,000
Fulton	37.27 state, 226.48 co.	{91,000* 109,000‡	55,000 75,100
Hancock	50 hard surf., 150 mac.	250,000	200,000
Hardin	All.	....	....
Holmes	None.	....	{40,000† 10,000*
Logan	840 gravel & stone.	255,000	146,000
Meigs	Conc., mac., brk.	7,500	9,000
Mercer	22 mac. & conc.	3,000	....
Ottawa	30 macadam.	30,000	18,000
Pickaway	23 gravel, 20 tar, 4 conc.	....	....
Pike	1100	....	36,000
Putnam	35 W. B. macadam.	38,000	150,000
Sandusky	75 state, 25 co.	{50,000* 30,000†	45,000* 23,000†
Shelby	868 gravel, dirt, mac., tar, conc.	167,000	175,000
Williams	80 mac., 10 conc.	50,000	30,000
Oklahoma:			
Carter	300 gravel & dirt.	50,000	75,000
Ellis	115 dirt & sand clay.	6,000	8,000
Garfield	303 dirt.	39,906	8,200§
Grady	237½ state, 1400 twp. rds.	25,000	40,000
Jackson	190	7,500	10,000
Major	278	12,899	Same
Oregon:			
Grant	850	20,000	23,000
Pennsylvania			
Delaware	72 tarvia.	40,000	75,000
Jefferson	100	....	....
Lackawanna	21 asph. conc.	100,000	100,000
Monroe	70—1000 in dists.	{80,000¶ 18,000*	15,000
Warren	25 conc. & mac.	5,000	....
So. Carolina:			
Aiken	69.8	15,000	20,000
Anderson	Ave. cost of maint. $1300 per mi.	....	60,000
Cherokee	63 top soil, 8 clay stone.	281,000	....
Chesterfield	18 gravel	2,400	3,000
Greenwood	2.02 conc., 111.4 top soil, 1.6 earth.	31,604	32,000
So. Dakota:			
Clay	192	20,753	16,000
Codington	11 gravel, 250 earth	15,701	16,000
Custer	Park work.	6,000	10,000
Day	28 dragging.	16,000	16,000
Douglas	247 dirt.	8,942	9,057
Faulk	220 dirt.	7,000	8,000
Gregory	200 earth.	15,000	12,000
Haakon	200 dirt.	5,000	4,000
Hanson	256	8,500	10,000
Jackson	200 dirt.	4,000	4,000
McCook	Some farm dragging on dirt rds.	8,000	10,000
Meade	550 dirt.	25,000	16,000
Miner	.....	6,000	6,000
Roberts	450	22,300	....
Spink	.....	25,000	25,000
Sully	120 earth.	2,000	3,000
Yankton	220 earth.	28,500	30,000
Tennessee:			
Bradley	353 dirt & gravel.	7,000	8,000
Claiborne	50	3,000	5,000
Cocke	100 W. B. macadam.	25,000	25,000
Grundy	40 earth.	5,000	9,000
Hamilton	600	100,000	100,000
Hawkins	320	5,200	8,000
Jefferson	200	17,000	17,000
Lewis	24 dirt.	2,000	5,000
Montgomery	30	12,000	10,000
White	5.15 clay, 40 W. B. mac.	37,450	40,000
Texas:			
Aransas	87 shell	....	15,000
Colorado	36 gravel, 200 dirt.	25,500	26,000
Comanche	206 graded.	21,632	51,478
Johnson	100 dirt, 100 gravel.	60,000	75,000
Madison	None	....	4,000
Newton	40	....	....
Smith	Gravel, earth.	50,800	50,000
Tarrant	150 pav., 660 grav., 198 sand-clay, 35 dirt.	....	....
Wichita	576 total, 37 conc.	....	....
Wise	30 shell gravel, 30 sand-clay, 20 earth or sand	10,000	11,000
Virginia:			
Augusta	200 mac., 900 earth.	75,000	75,000
Fairfax	10 W. B. mac., surf. treated, 26 gravel.	15,000	15,000
Halifax	100 soil	15,000	18,000
Scott	200	25,000	30,000
Washington:			
Asotin	20 crushed rock, 25 gravel, 300 earth	30,000	33,000
Callam	90 gravel	46,000	47,000
Douglas	61 surf. hwys.	27,000	31,000
Grant	200 gravel surf.	55,000	60,000
Grays Harbor	30 conc., 3 asph., 300 gravel	120,000	100,000
Island	225 dirt & gravel	30,000	25,000
Jefferson	170 gravel	28,656	Same
Lewis	900	{285,083 Co. 51,412 St.	{293,148 46,482
Lincoln	210 gravel & mac.	61,000	61,000
Okanogan	60	26,000	25,000
Pierce	96 paved & gravel	68,000	69,000
San Juan	140 earth & gravel	16,189	16,500
Snohomish	140 conc., 360 gravel	200,700	160,000
Whitman	106 crushed rock	104,000	104,000
W. Virginia:			
Braxton	650 earth	13,000	20,000
Brooke	54 impr., 126 unimpr.	153,693	90,000
Hancock	33.52 brk., 8.72 conc., 140 earth, 2.7 others	25,000	34,000
Mason	850	....	....
McDowell	200; 50 conc. & asph. Ky.	50,000	50,000
Mineral	18 bitum., 100 earth	35,000	35,000
Monongalia	30 impr., 1,000 unimpr.	100,000	49,000
Polk	325 gravel & dirt	75,000	50,000
Upshur	745¼ dirt, 4¾ dirt	12,000	14,000
Wyoming	500	100,000	110,000
Wisconsin:			
Adams	96 sand & clay, 2 mac.	16,000	19,000
Brown	400 gravel & mac.	106,000	100,000
Buffalo	200	30,000	....
Fond du Lac	12 conc., 408 dirt & gravel	94,799	80,000
Forest	60	32,500	52,000
Grant	475 earth, gravel & mac.	101,469	99,000
Jefferson	200	67,000	74,000
Juneau	220 clay & sand	40,000	35,000
La Crosse	146	36,893	35,045
Lincoln	215 earth & gravel	39,421	50,000
Monroe	425 sand & clay	57,000	74,000
Price	25	24,000	32,000
Sawyer	265 dirt	29,000	35,000
Vernon	400	112,299	92,000
Walworth	278.5 conc., grav., mac.	113,530	94,000
Waukesha	15	9,000	....
Winnebago	165 all kinds	12,000	Same
Wyoming:			
Weston	30 earth	12,000	same

*County.
‡State.
†State to County.
§To July 1.
¶Districts.

NEWS OF THE SOCIETIES

CALENDAR

Apr. 19—NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Bldg., New York City.

Apr. 19-21—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. General meeting. Chicago, Ill.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartanburg, S. C.

Apr. 20—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Meeting called by committee of organization at Hotel Commodore, New York. General secretary, W. S. Hays, Drexel Building, Philadelphia.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Cleveland, O.; April 28, Massillon, O.; April 30, Youngstown, O.

Apr. 29—DETROIT ENGINEERING SOCIETY. Hotel Cadillac, Detroit, Mich.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 9-11—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. Atlantic City, N. J.

May 12 — NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Clevland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

BROOKLYN ENGINEERS' CLUB

An informal smoker and get-to-gether meeting was held April 6, in the club house.

As a specially interesting feature, the club had as its guest of honor Captain Clarence F. Foster, athletic director of the Polytechnic Institute of Brooklyn, who spoke on "Keeping the Business Man Practically Fit."

Refreshments were served.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular business meeting April 5, Gustav Lindenthal presented a paper, illustrated by lantern slides, on "The Continuous Truss Bridge Over the Ohio River at Sciotoville, Ohio, for the Chesapeake and Ohio Northern Railway."

THE SECOND NATIONAL CONFERENCE ON STATE PARKS

The Second National Conference on State Parks, which has been called in the interests of State park development by John Barton Payne, chairman of conference, will be held at the Bear Mountain Inn, Palisades Interstate Park, New York, from May 22 to 25, 1922.

The First National Conference on State Parks was held in Des Moines, Iowa, in January, 1921, for the purpose of stimulating interest in state park systems, especially with a view to future requirements and the acquisition of lands suitable for preserves and reservations in all states, before advancing real estate values, makes such acquisition prohibitive.

In New York State increasing recognition has been given to the value of the Adirondack Forest Preserve, Catskill Forest Preserve, the Palisades Interstate Park, Bronx River Parkway and the recently created Allegany State Park, as the main elements of a state-wide park system.

Considerable thought has also been given to the development of a great outer park system for New York City, the basis of which is the Croton Watershed, 360 square miles in extent, and connected with the city by the Bronx River Parkway, on which construction work is now nearing completion.

The program of the coming Second National Conference on State Parks will include an inspection of the Palisades Interstate Park, the new Storm King Highway, New York Zoological Park and Bronx River Parkway Reservation. Special interest will also be centered in Westchester County on account of three bills just passed by the Legislature and approved by the Governor. One of these bills conveys Mohansic Lake Reservation of 1100 acres of Westchester County for park purposes; another authorizes the establishment of a county park system, which will include extensive beaches on the Hudson River and on the Sound, and the third bill authorizes the Bear Mountain-Peekskill bridge across the Hudson.

AMERICAN WATER WORKS ASSOCIATION CONVENTION TENTATIVE PROGRAM

May 15—Forenoon and afternoon, Group Meetings. Evening, President's Address, Reception and Dance.

May 16—Forenoon, Business Section, Report of Publication Committee, Report of Finance Committee; G. W. Fuller, Philadelphia Water Supply, Present and Proposed; F. C. Jordan, Fire Prevention and Fire Protection in Relation to Public Water Supply. Afternoon, J. Waldo Smith, Development of the Schoharie Watershed, Catskill Water Supply; M. M. O'Shaugnessy, the Hetch Hetchy Water Supply; John H. Gregory, Tentative; Wm. A. Megraw, the Construction of the Loch Raven Dam; G. E. Willcomb, Twenty Years Filtration Practice at Albany; Election of Members for Nominating Committee. Evening, *American Water Works Association Manufacturer's Program.* Moving Pictures Showing 20,000 H.P. of High Pressure Steam Being Discharged to Atmosphere and Shut off in 30 Seconds by Dean Control; Short Paper by Peter Payne Dean; Thomas F. Wolfe, Underground Leakage and its Relation to Mains and Services; John Oliphant, Pneumatic Pumping, Up-to-Date.

May 17—Forenoon, Report of Special Committees, Committee on Standard Forms of Contract; Report of Council on Standardization; Report of Committee on Industrial Wastes in Relation to Water Supply; Report of Committee on Watershed Protection; George R. Taylor, Problems in the Reforestation of Watersheds; Selection of time and place for next meeting. Afternoon, Trip (2.30 to 5.30 o'clock). Evening, J. W. Ledoux, Some Observations Concerning Wood Pipe; Report of Committee on Standard Specifications for Cast Iron Pipe and Specials; C. E. Inman, Experience with Cast Iron Water Pipe for Pressures Higher Than Allowed by Current Specifications; Peter Gillespie, Centrifugally Cast Iron Pipe (with slides); Theatre Party (Ladies).

May 18, Superintendent's Day—Forenoon, L. H. Enslow, Water Chlorination Control in Virginia; Report of Committee on Physical Standards for Distribution Systems; M. M. Borden, Air and Relief Valves; Wm. P. Mason, Instances of the Value of a Sanitary Survey; F. A. McInnes, Causes of Failure of Cast Iron Pipe; Topical Discussion, Breaks in Water Mains; Other Topical Discussions. Afternoon, George E. Cripps, Equipment and Shop Facilities for Maintenance of Water Works Systems; Topical Discussion; W. R. Conard, Present Day Tars for Pipe Coatings; Topical Discussions. Afternoon, *Chemical and Bacteriological Section.* Report of Committee on Standard Methods of Water Analysis; Report of Committee on Colloidal Chemistry in Relation to Water Purification; Report of Committee on Testing Water

(Continued on page 276)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

NEW STEAM SCARIFIER

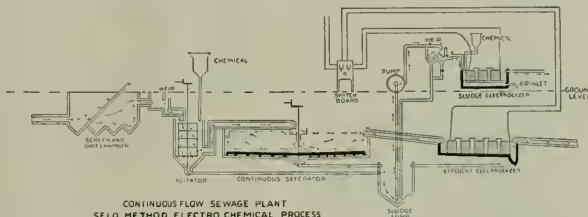
A new Steam Scarifier to be attached to the Case Road Roller, has just been announced by the J. I. Case T. M. Co., who claims that it has several distinctive advantages and features that contribute to its general durability and efficiency.

The roller has ample power to handle the scarifier, operating economy, ruggedness and dependability, flexibility and easy control of outfit, essential to withstand the severe work often encountered. The steam rollers with scarifier attachment have all steel gearing. Spring cushions in the differential gear assembly serve to absorb all sudden strain thrown on the gearing.

The scarifier is attached to the rear of the roller and the same operator handles both. The additional weight of the complete attachment is about 1,850 pounds. A steam pressure cylinder, which is under instant control of the operator, by manipulating a four way valve, is employed to raise and lower the teeth. The teeth are forced into the ground under a steam pressure of 4 tons and are held there by a steam cushion. The picks are quickly raised or lowered in passing over cross walks, manhole covers and other immovable obstacles.

The six 1½ x 2½ x 22-inch scarifier teeth are made of tool steel accurately forged and carefully tempered. The picks are adjustable for depth and gauge wheels prevent them from digging below the required depth in case the rear rolls drop into a hole in the road.

The width of cut can be varied from 40 to 56 inches, depending on the spacing of picks or any picks can be removed.



CONTINUOUS FLOW SEWAGE PLANT
SELO METHOD ELECTRO CHEMICAL PROCESS

ELECTRICALLY CONTROLLED PENETROMETER

After seven years of experimental work an electrically controlled penetrometer has been perfected, for use in testing laboratories, to automatically time penetration tests of plastic substances.

It is manufactured by Howard & Morse and is recommended by them for the elimination of personal equation when testing asphalt, bitumen, tar, rubber and other material, where the unknown factor of human error is claimed to be replaced by clockwork accuracy. The instrument contains a timing device by means of which an electric current, acting through a magnet, releases a bar carrying the penetration needle, allowing penetration to be effected for a given period, at the expiration of which the bar is automatically clamped by the magnet and the depth of penetration measured.

The instrument can be connected to six dry cells or their equivalent or the current may be supplied from 110 volt direct circuit, connecting through a reducer or from 110 volt alternating circuit, connecting through a rectifier.

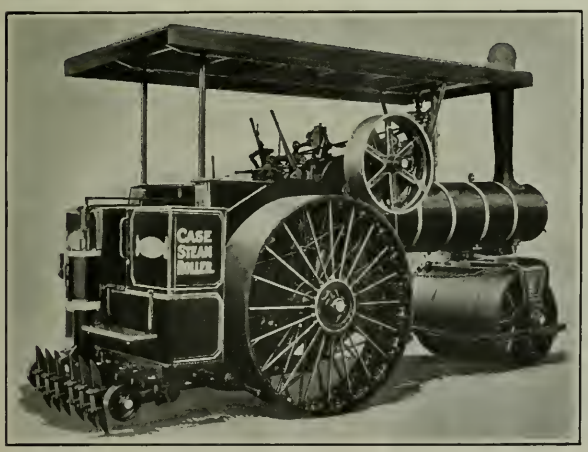
SELO METHOD CHEMICAL SEWAGE DISPOSAL

The continuous flow sewage plant, Selo method of electro chemical process purification, is described in a Monograph issued with compliments of Gelinas Engineering Co., Inc., licensee of the patented Selo method.

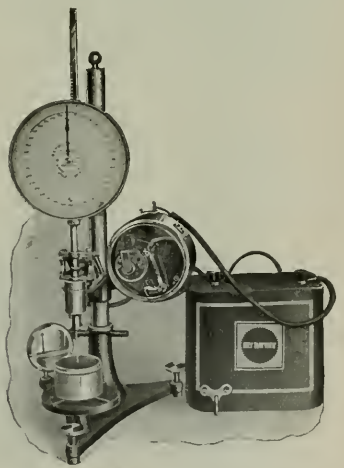
This method, largely automatic in operation, is claimed to produce any desired purification ranging from the separation of the solids to a very complete elimination of germs, according to the varying requirements of the state boards of health, and producing a product of known purity at a fixed price.

This method, which requires only a relatively small acreage, delivers the sewerage, directly from the sewer to a measuring chamber where a float valve operates the automatic control of chemical and electricity in proportion to the varying flow of the sewage.

The sewage then passes to the agitator where it is mixed with a chemical and passes into a large tank, flowing in through the center, and out over the rim. The action of the chemical and the agitation causes the suspended matter to



CASE STEAM ROAD ROLLER WITH SCARIFIER ATTACHMENT



HOWARD & MORSE'S PENETROMETER

gather and settle to the bottom of the tank. The effluent from the latter being clear and sediment which is drawn to a central sump by revolving scrapers.

The sediment sludge passes through an electrolizer where rock salt is added and electric current passed through the mixture while the latter is agitated by compressed air. This treatment kills all germ life present. Afterwards the sludge is run on a sand bed and rapidly drained and dried, and it may be used to great advantage as a fertilizer.

The liquid effluent from the perciptation passes in thin sheets between the electrodes of the electrolizer that liberates oxygen which intensely attacks the organic matter contained in the sewage and virtually burns it up. The electricity also immediately sterilizes all bacterial life. The effluent from the electorlizer is therefore stable as shown by samples kept for months in bottles without developing any odor, while samples of raw sewage taken at the same time became offensive within a day or two. In the clear effluent both the germs and their food have been eliminated and the water can be run into public streams without danger to public health.

The apparatus may be installed anywhere or can be built to accommodate any flow of sewage in towns, cities or in the open country and will not attract or bred insects.

RUSSELL ROAD FINISHER

The new road finisher, made by the Russell Grader Mfg. Co., is notable for its jointed 15-foot blade made with three 5-foot sections and equipped with a cutting edge easily removable for sharpening or replacing. The jointing of the blade provides for setting it to secure any contour that may be desired. It is suspended by a powerful worm gear mechanism from a circle which is reversible, allowing operation on either side of the road. Compensating springs permit the operator to make quick adjustments and the receding platform gives the operator full and unobstructed view of the blade. The machine has a wheel base of 114 inches and a front tread of 53 inches, and rear tread of 93 inches.

The machine is operated by one man. It weighs 3,200 pounds and is designed to be hauled with from 4 to 8 horses or a 12 to 20-h.p. gas tractor. It completely finishes or planes the road from shoulder to shoulder in one round trip.

(*Continued from page* 274)

Works Materials and Supplies, Lime Specifications. Evening, S. T. Powell, Industrial Water Supplies; David A. Decrow, Reciprocating Pumps; S. P. Felix, Turbo-Centrifugal Pumps; Smoker (Men); Card Party (Ladies).

May 19—Forenoon, Joint Session with Chemical and Bacteriological Section. Frank E. Hale, Plant Control of Chlorination by the Excess Chlorine Method as Employed in New York City's Water Supplies; W. W. Brush, Responsibility of the Water Works Superintendent to Prevent Tastes and Odors Due to Microscopic Organisms; W. A. Sperry, Further Notes on Chlorine Control at Grand Rapids; Norman J. Howard, Recent Practice in the Removal of Odors by Aeration, Filtration and Other Processes; Wm. J. Orchard, Recent Developments in Chlorination. Afternoon, Report of Committee on Meter Schedules; T. A. Leisen, Steel Pipe; G. A. Elliott, Steel Pipe; Wm. A. Megraw, Design, Construction and Operation of a Balancing Reservoir. Afternoon, Chemical and Bacteriological Section, Symposium on Tastes and Odors; From Sewage Pollution; H. E. Jordan, the Effect of Wastes from Oil Refineries Upon the Operation of the Filter Plant at East Chicago; From Chlorine Treatment; F. H. Waring, Tastes and Odors from Decomposition and Putrefaction of Organic Material in the Maumee River Water; George C. Bunker and Henry Schuber, Reactions of Culture Media; Norman J. Howard, Chlorination Prior to Filtration, with Special Reference to Efficiency, Economy and Removal of Excess Chlorine; Edward Bartow and G. C. Baker, Water Softening by Base Exchange.

DEPARTMENT OF LABOR AND INDUSTRY, COMMONWEALTH OF PENNSYLVANIA

The largest labor convention ever held in Pennsylvania will be brought to Harrisburg in May of this year. The occasion is the Ninth Annual Convention of Governmental Labor Officials of the United States and Canada to be held May 22 to 26.

Clifford B. Connelley, Pennsylvania Commissioner of Labor and Industry, has invited labor commissioners of the United States and Canada, seventy-five in number, to be present in the hope that a convention of commissioners may be held in connection with the conference. This feature of the conference would have many of the advantages toward unification of administrative policy that were found in the assemblage of governors of the various states in Harrisburg two years ago. The annual meeting of the Department of Labor and Industry will be held at this time. Safety engineers will get together to form a state-wide organization to cooperate with the department.

The tentative program of the governmental Labor Officials Convention includes a child welfare session, inspection, safety and sanitation session, employment, mediation and conciliation, workmen's compensation, medical supervision, and rehabilitation sessions, and a minimum wage and hours session.

In addition to the state officials who are expected to attend the convention there will be large delegation of labor officials representing the Federal Government on problems of nation-wide importance. Not less than one thousand people are expected to be present during the conference.

RUSSELL ROAD FINISHER HAULED BY TRACTOR.

MUSCLE SHOALS

The Committee on Military Affairs of the House of Representatives is about to conclude an exhaustive hearing which has set forth very clearly the many ramifications of the situation surrounding the offers made by Henry Ford, by the Alabama Power Co., and by other interests. A party of 25 or 30 Senators probably will visit Muscle Shoals shortly after the vote is taken on the Four-Power Treaty. Sentiment in Congress in regard to the disposal of government properties at Muscle Shoals is so divided that it seems unlikely that any definite action in the matter will be taken in the near future. Senator Norris has announced that he is preparing a bill, proposing to create a government owned corporation empowered to develop and operate the nitrate and water power projects.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 April 22, 1922 No. 16

North Avenue Viaduct, Milwaukee

Excavation for substructure. Arrangement and installation of contractor's equipment. Steel centers for arch spans. Concreting superstructure.

The North Avenue viaduct, Milwaukee, is a reinforced concrete structure 1,385 feet long with a side approach about 550 feet long. The viaduct has a 40-foot roadway and two 10-foot sidewalks. It is about 67 feet in maximum height and consists of a retained embankment, steel plate girder spans, and reinforced concrete girder spans and columns for the approaches to three main river spans, each span having two arch ribs from 155 to 166 feet in clear span and all supported on reinforced concrete footings built in open excavation on shore and in the river channel at a maximum depth of about 24 feet below normal water level.

The side approach has a roadway 23 feet wide and no sidewalks. Its construction was entirely of reinforced concrete. The total amount of excavation was about 14,000 cubic yards and the total amount of concrete for the structure was about 17,000 cubic yards. About 1,000 tons of reinforcement steel and 200 tons of structural steel were used in the structure. About 1,500,000 feet board measure of lumber were required for falsework and forms.

The new bridge replaces a four-span pin-connected steel truss, deck bridge with 17-foot roadway and 8-foot sidewalks that occupied the same alignment but with a lower grade. It was substantially level at an elevation of about 40 feet above normal water level.

The contract was awarded Feb. 10, 1920 to Klug & Smith Co., Milkaukee, Wis., for a price of $628,000 and with a time limit of 400 working days. On account of difficulty in securing the necessary materials, work was not actually commenced until July 12, 1920. The old bridge was closed to traffic August 13, pedestrians being diverted to a temporary pile trestle bridge, located about 200 feet upstream from the old bridge. The old trusses were shored up and traffic on them was maintained for some time while the old abutments were removed to permit operations to begin as early as possible on the excavation and the construction for the piers and abutments for the new spans.

*Description of river spans and approaches was published in PUBLIC WORKS for February 11.

After the piers and abutments had been constructed to the level of the spring line, the old pin-connected truss bridge was moved bodily about 7 feet upstream, in which position it was used to support the arch form trusses during erection and over which were carried all timbers, forms, reinforcing steel, etc. for the south arch ribs. It was then carefully match-marked, disassembled by a traveling hand derrick and, being the contractor's property and being in good condition, was stored for reassembling or for sale.

COFFERDAMS

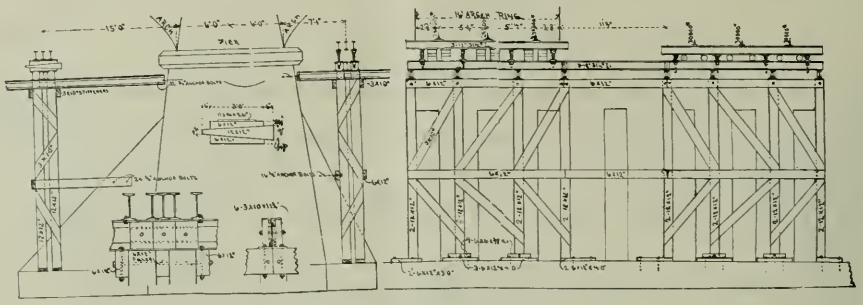
The contract provided for the lowering of water level by means of a control dam so that the substructure could be built more advantageously. Water was accordingly lowered about 10 feet, reducing the width of the channel to about 200 feet and the maximum depth of water at the site to about 6 feet, and thus permitting the 40x81-foot footings for the two channel piers to be constructed in the cofferdam excavation from 12 to 16 feet below the original surface of the river bottom. The excavations were made partly by hand and partly by a clamshell bucket operated by a derrick on the floor of the old bridge and partly by a steam shovel.

The 80x120-foot cofferdams were sheeted with 4x12-inch floor planks 18 feet long, removed from the old bridge and driven by a steam hammer. These cofferdams had no interior bracing, but the 12x12-inch waling pieces bearing against the tops and intermediate portions of the sheet piles were tied with cables to the old foundations.

The river bottom inside this cofferdam was excavated to a depth of about 4 feet on a natural slope and a new 44x85-foot cofferdam was built concentric with the old one. Besides being sheeted, it was lined as the excavation progressed with horizontal 2-inch planks bearing against outside rangers and against inside vertical 1½-inch round bars 4 feet apart, driven firmly into the river bottom and having their upper ends secured by wire ties to the sheet piles in the outer cofferdams. The excavation was then completed in the inner cofferdam. Pumps were provided between the inner and outer cofferdams to

pump from during the pier construction. After the concreting had been completed, the vertical 1½-inch rods were pulled out and used for reinforcements in the permanent structure.

sheave and thence around it and at right angles to the tracks to the second drum of the hoisting engine. At the river end of the first part of the hauling line and of the land end of the other part there were



FALSEWORK BENT SUPPORTING STEEL ARCH CENTERS.

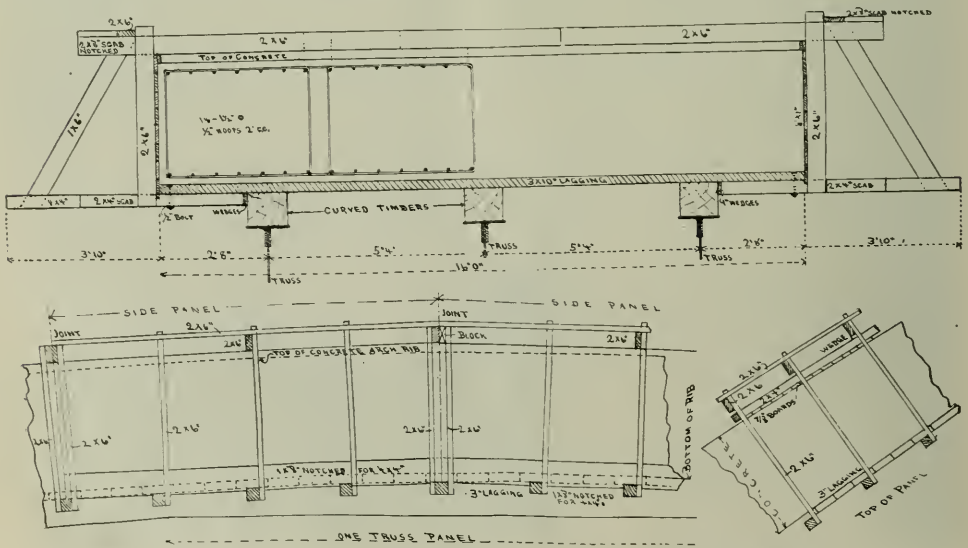
GENERAL INSTALLATIONS

The contractor's plant and office were located on the west bank of the river where concrete materials, reinforcements and other supplies were stored, shops established and a concrete mixing and distributing plant installed. Materials were delivered on a railroad siding 500 feet long, parallel and adjacent to the west end of the bridge, and cars were switched from this track to a parallel track by means of an endless hauling cable about 1,300 feet long, operated by two drums of a 40 horsepower stationary hoisting engine set near the river bank. One part of this hauling cable was led around a guide sheave and run 575 feet parallel to the two tracks, around two tail sheaves 21 feet apart, and back parallel with itself outside the second track. returning to a guide

placed shackle attachments for snap chains by which the cars were hauled back and forth on the siding or the other tracks, thus spotting them wherever required for unloading ,and eliminating expensive services of a switch engine. The guide sheaves were set in steel frames anchored by four 20-inch vertical bolts to concrete pedestals 3 feet square and 4 feet deep.

SAND AND STONE SUPPLIES AND BINS

About 1,000 yards of sand and an equal amount of broken stone were maintained in storage in long narrow piles one on each side of the two service tracks. The materials were unloaded from railroad cars by a 1¼-yard Williams clamshell bucket suspended from the 90-foot steel boom of a derrick, operated by an American hoisting engine and com-



FORM FOR ARCH RIB; ALSO SHOWING ARRANGEMENT OF REINFORCEMENT.

RIVER ARCH SPANS AND VIADUCT APPROACHES.

manding the stock piles from which material was reclaimed as required to keep filled the elevated storage bins with a capacity for 200 yards of stone and 100 yards of sand. The derrick had stiff legs about 66 feet long and their center points were stiffened by inclined struts. They were securely anchored to concrete pedestals which served as counterweights. The mast and sills were supported on concrete pedestals about 10 feet above the surface of the ground. The pedestal under the mast was 3 feet square and had a 5x5-foot footing. The 24x24-foot engine platform was in the center between the sills and was supported from the ground by timber columns.

Sand and stone hoppers 20x24 feet in plan, and about 30 feet deep on the lower side and 10 feet deep on the upper side, were built on the slope of the bank with the inclined bottoms approximately parallel with the surface of the ground. The bins were lined with 2-inch vertical planks nailed to 6x12-inch horizontal girts, bearing on 6x12-inch vertical posts connected by five tiers of tension members, each having four 1-inch horizontal tie rods passing through the bin to resist the internal pressure. The bin was divided into two unequal compartments by an internal transverse partition made of planks nailed to one surface of 2x12-inch horizontal cross pieces. At the narrow bottom of the bins the walls converged to sectorial steel gates 8 inches high by 12 inches wide, that delivered into the measuring hoppers supported by vertical posts that carried a portion of load from the adjacent cement storehouse with a capacity of 6,000 bags.

CONCRETE MIXING

The hopper in the bottom of the storehouse floor received cement as the bags were emptied into it and delivered it to a 10x10-inch vertical chute also terminating in a sectorial valve above the measuring hopper. The latter hopper delivered directly to the 1-yard steam driven Smith mixer that discharged its contents into the hoisting bucket at the foot of an Insley steel tower, 220 feet high.

Mixing water was delivered from a cylindrical tank filled to the proper quantity as indicated by a float gage, and discharged through a quick opening valve capable of delivering 35 gallons in 10 seconds. The discharge was a homemade device consisting of a 5-inch vertical pipe with a flange gasketted to a pine collar in the bottom of the tank. The upper edge o fthe collar was beveled, affording bearing for a 6-inch standard high-pressure copper ball, suspended from the long arm of a horizontal lever fulcrumed on the edge of the tank. A hand rod attached to the other end of the arm enabled the ball to be raised instantly and the contents of the tank immediately discharged to the mixer.

DISTRIBUTING CONCRETE

From the top of the tower, concrete was delivered both east and west through chutes suspended from cables attached to the tower on both sides. Concrete for the first of the channel spans and for the adjacent portions of the viaduct, was delivered directly by the chutes arranged and shifted as required and distributing the concrete up to distances of about

ABUTMENT PIER AND END SPAN.

325 feet maximum horizontally, thus covering the first of the main spans of the bridge. For the last two spans the concrete was spouted nearly 400 feet to a receiving hopper at the foot of an 80-foot steel tower and was then hoisted to the top of this tower and spouted to the shore end of the last span, serving the superstructure and the abutments there by means of a chute suspended from a cable attached to the top of the tower. For the construction of the center span the concrete was diverted from the main chute connecting the 220-foot tower with the auxiliary tower and was spouted through an auxiliary chute inclined toward the main tower and supported on a movable A-frame, shifted as required on the falsework for the spans. The 80-foot tower was situated on one of the river piers.

On the shore side of the main hoisting tower the chute was extended about 200 feet to a hopper mounted on the 35-foot mast of a derrick installed on the top of an 80-foot wooden tower and supplying a counterbalanced Insley system of chutes comprising one 50-foot boom section, two 50-foot sections supported on counterweighted cantilever trusses, and two 30-foot end sections that furnish a very flexible arrangement serving nearly 200 linear feet of the viaduct. The maximum distance that concrete was spouted from the 220-foot tower was 400 feet, and the total amount of concrete hoisted in this tower was about 16,000 yards. Besides the concrete handled by this system, about 1,000 yards, for remote parts of the viaduct and for footings and other purposes, was mixed in one half-yard portable Koehring machine and one 1-bag mixer, besides which there was provided a C. H. & E. mortar mixer at first intended for making concrete for the ballusters, which was not eventually used. The main mixing plant was served by an average force of six men including those required for unloading and handling the aggregate and for operating the tower hoists and chutes. The best record made was 350 yards of concrete mixed and placed in one 8-hour day and the greatest rate of mixing was 45 one-yard batches per hour.

The concrete for the arch ribs was placed simultaneously in making both sections, commencing at the skewbacks, each section being finished against a radial bulkhead, forming a construction joint separating one day's concreting from another. A maximum of 10 hours was required for concreting one section of the arch ribs. The centers were struck when the concrete was 30 days old, and no appreciable settlement occurred. There had been recorded a deflection of about 1 inch produced by the dead load of the concrete. This amount corresponded closely with what had been anticipated and prepared for by the super elevation of the centering.

The concreting of the spandrel columns and floor was continued as rapidly as convenient after the completion of the arch ribs and the work progressed continuously until the floor and sidewalk slabs were concreted, after which the balustrade railing was constructed in a separate operation. The balustrade was made with a base part cast in position and about 3,000 heavy round ornamental reinforced concrete balusters were precast in advance by a gang of four men working in a shop established under one of the approach spans. They were made of 1:3 hand mixed mortar at the rate of about 50 per day, for which 46 cast iron molds were provided. They were cast upside down to improve the exposed surface. The balusters were then placed on top of the railing base and the newels and top rails cast in position and an excellent result obtained.

(To be continued)

State Licensing of Engineers

In our issues of February 25th and March 4th we published an article giving a brief abstract of the requirements of the various states regarding the licensing of engineers. An engineer living in Idaho has written stating that we had apparently overlooked his state in the list. As a matter of fact not only Idaho but three other states—California, Illinois and Wyoming, have laws regulating engineering in some degree, but we followed the example of the American Association of Engineers in omitting these four states from the list because their laws were not as comprehensive as the others.

California has a law requiring that all county surveyors or candidates for that office be licensed surveyors.

Illinois has a law for the registration of structural engineers, this including those who design and supervise the construction or alteration of structures, such as those for electric power plants, water works, sewage disposal plants, bridges, etc. The fee for examination is $10 and for the certificate $5, with $1 for annual renewal.

Wyoming requires a certificate for those practicing surveying and engineering in respect to drainage, highway, municipal, county or state projects, the surveying of property lines or rights of way, or the preparation of applications for permits for use of water. The charge for examination is $10 and for certificate without examination $5.

The Idaho law provides for the registration of civil engineers, this including all branches of engineering except mining, metallurgical and military. Examination is required for all applicants except those from other states, a non-resident practitioner being granted a certificate without examination if licensed or registered in another state whose requirements are equally as stringent as those of Idaho. These requirements are those for the degree of civil engineering of the State University of Idaho. The fee for registration is $10 for residents and $25 for non-residents, with $2 for annual renewals.

Use of Porous Sub-Base

In connection with other information concerning paving work in this city which was recently furnished us through the courtesy of John D. Seright, city engineer of Elwood, Ind., Mr. Seright makes the following observation: "I find no construction that holds up better under frost conditions and traffic than a base of coarse crushed stone. Even in concrete or bituminous bases it permits the water to escape readily, prevents capillarity and the consequent upheavals and cracks. I believe that four inches to six inches of this construction is well worth the additional cost in giving greater stability and arching over or spreading the load stresses to a firmer and drier sub-grade."

Wear Tests of Concrete

Bulletin 10 of the Structural Materials Research Laboratory, Lewis Institute, Chicago, contains 24 pages of diagrams, descriptions of tests and other data concerning the wear of concrete by Duff A. Abrams, Professor in charge of laboratory.

Although principal consideration is given to the result of wear tests, in nearly all instances parallel compression tests were made. The wear tests were made in the Talbot-Jones rattler run for 1,800 revolutions at the rate of 30 r.p.m. and charged with thirty 3¾-inch balls and 135 1⅞-inch balls, having a combined weight of about 200 pounds. The concrete blocks which formed the detachable lining of the drum were weighed before and after the test. The high-grade concrete showed a wear of about ½ inch and poor concrete lost as much as 2 inches.

The wearing qualities were considered to be affected by: Method of conducting the test, quantity of mixing water, quantity of cement, grading of aggregate, grading of coarse aggregate, comparison of different fine aggregates, comparison of different coarse aggregates, hydrated lime and other powdered admixtures, relation of compressive strength to wear, age of concrete, time of mixing concrete, curing condition of concrete.

This report contains brief résumés of these investigations. About 10,000 wear blocks have been tested, as well as several thousand compression cylinders and miscellaneous specimens. Tests were usually made at the age of 3 months after storing the blocks for 14 days in damp sand or moist air and the remainder in air at ordinary humidity.

The following are some of the conclusions based on the wear and compression tests of concrete covered by this report:

"The wear on separately molded concrete blocks tested in the Talbot-Jones rattler was much more severe than any encountered in service; however, the test is believed to give trustworthy information on the wearing resistance of concrete of various proportions, consistencies, curing conditions, ages, etc., for use in concrete roads and pavements. * * *

"In general the factors which gave concrete of high strength also gave concrete of low wear (a high *resistance to wear*).

"Increasing the quantity of cement reduced the wear.

"Increasing the quantity of mixing water, beyond the minimum required to produce a plastic concrete, caused a material increase in the wear.

"The coarser the grading of the aggregates, up to certain limits, the lower the wear.

"Curing concrete under favorable conditions exerted a marked influence in reducing wear.

"Wear was materially reduced by longer mixing of the concrete.

"Wear was reduced (resistance to wear increased) with the age of the concrete.

"The quality of the fine or coarse aggregate produced less effect on wear than is commonly supposed. The wearing resistance of concrete is determined largely by the *quality of concrete* rather than by the type of aggregate. Good concrete can be produced from aggregates which are generally considered inferior, if other factors are properly taken into account."

Reclaiming Land at Belle Isle

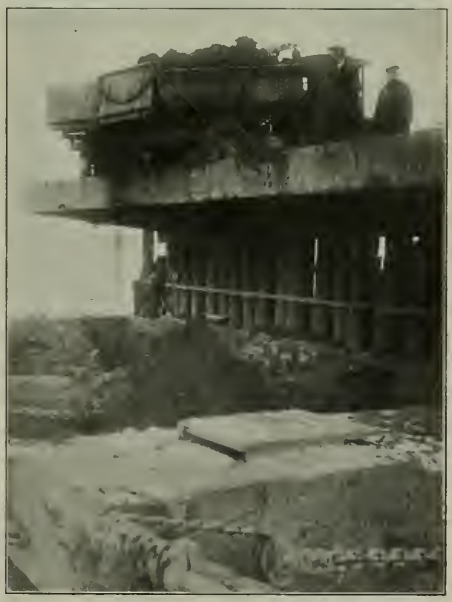
By W. K. Crosson

Earth from city excavations is dumped in water off shore and placed inside dike by hydraulic dredge.

Detroit will add two hundred acres to Belle Isle, the city's playground, within the next five years. A triangular dike has been constructed and when the space that it encloses is filled in, it will add 45 acres to one end of the island. This will make the site for the $500,000 James Scott memorial fountain, which is now in the course of construction. This reclaimed land is estimated to have a value of $20,000 an acre and will increase the size of the island to over 900 acres.

In order to carry on this work, the city engineers started a reclamation program, in connection with which there are some unique engineering features. For instance, the dumping dock, where earth is dumped into city scows to be towed to the island, is 260 feet long and 115 feet wide at the river's edge and is reinforced with 46 tons of steel, and has as a unique feature a flaring edge, which overhangs 14 feet and permits a scow to get half its width under the dock, which allows the trucks to dump the earth directly into the middle of the scows.

The earth is hauled to this dock from the different construction jobs throughout the city, the truck



DOCK WITH OVERHANG FOR DUMPING INTO SCOW.

owners paying the city $1.50 a load for the privilege of dumping. This revenue already is at the rate of $100,000 a year. The contractors are so glad to use the dock for disposing of excavated material that the city had to put two men on the dock as traffic officers to see that the trucks unload quickly and move off the dock, eliminating all tie-ups.

Three scows valued at $30,000 each with a capacity of 650 cubic yards or 130 truck loads, were purchased by the city in New York and towed to Detroit through the New York barge canal.

Tugs tow the loaded scows to a point opposite the dike, where a basin 17 feet deep, 200 feet wide and 700 feet long has been dredged in the bottom of the river. Here the scows dump the load through trap doors in their bottoms. A hydraulic dredge sucks up this earth and forces it through a 16-foot pipe to the area enclosed by the dike. By adding lengths of pipe the "soup" can be pumped to any spot within the dike. The dredge being used is valued at $175,000, but was purchased second hand by the city for $42,000 and renamed the "By Heck" in honor of Colonel Heckel, commissioner of parks and boulevards.

HYDRAULIC DREDGE AT BELLE ISLE.

The idea of dumping the earth into a submerged basin and then pumping it out again was declared impractical by some engineers. They declared that the pump would become clogged by the stone, bricks, refuse, etc., sucked up. This has proved unfounded as there has been no difficulty experienced from this source, and the method has proven entirely successful.

There are other advantages occurring from the new dump; for one thing, it saves the city's streets from the wear and tear which would result if all the scores of trucks dumping there now had to make the longer haul to the older dumps in the outskirts. Thus the traffic situation is greatly relieved. Also, to the contractor the privilege of dumping at the rate $1.50 a load means a big saving because of the shorter haul than to the other dumps.

Cleaning Catch Basins in Boston

On March 20th bids were opened by Joseph A. Rourke, commissioner of public works of Boston, Mass., for cleaning catch basins in seven districts, the contract prices being based upon the cubic yards removed as the unit. The amounts estimated to be removed varied from a maximum of 8,000 in each of two districts to a minimum of 1,200. In the two largest districts the contract was awarded to the C. & R. Construction Company at $1.59 per cubic yard. There was one bid lower than this, namely $1.40 for District No. 7, for which 6,300 cubic yards were estimated. The next highest bid was $1.62 for District No. 3, 3,200 cubic yards; followed by $1.78 for District No. 6 with 3,400, and $1.89 for each of the remaining two districts for which the estimates were 2,400 cubic yards and 1,200 cubic yards respectively.

Construction of Franklin Highway*

By E. H. Sauerman

Safety devices on industrial track, on which cars are hauled by tractor, Equipment used

SAFETY DEVICE

The cars were protected on the steep grades by automatic safety devices placed on the rear cars. This consisted of a 25-pound rail, 30 inches long with one end bent to an angle and pivoted to the coupling pin of the draw head. The other end dragging on the ground at an angle of about 40 degrees with the horizontal was split to a forklike shape and immediately dug deeply into the ground and held the train in position as soon as the tension was relaxed on the hauling line. This device was tested several times and always as soon as the tractor slacked off, or on another occasion when the tow line broke, it operated instantly to hold the cars fast, and after its adoption three or four miles of concrete was laid without any wrecks at all, thus eliminating what otherwise might have been a serious danger.

As soon as the switching engine of Pecan Siding delivered a train to the foot of the first grade, the 3-ton locomotive was detached and the four-car train was hauled up the grade by one of three 10-ton tractors which were kept always in service while two more, one at the bottom and one at the top of the long grade, were held in reserve. The tractors had abundant power to haul trains of more than four cars, but it was decided to limit the train lengths in order to avoid excessive stress on the tractors. When the tractors arrived at the top of the grade the full cars were attached to a locomotive waiting there and taken on to the mixer. In going down grade the tractor was attached in the same manner to the cars and idled along with the empty cars, which it delivered to the locomotive at the foot of the slope.

HAULING TRAINS

The cars were hauled up and down the slopes by tractors because the tractors were available from government supply, and because the lengths and steepness of the grades and the many curves in them would have made the use of a hoisting engine and cable very difficult and expensive. The trains were hauled up the 9,000-foot slope at the second speed of the tractor in about 20 or 25 minutes and descended rather more quickly at the first speed of the tractor. The system operated very satisfactorily and without any accidents or delays whatever.

*Continued from page 257.

Although the industrial track was laid with heavy grades, the 50 cars used on it for hauling concrete to the mixer were not equipped with brakes, because their inadequacy and the usual inefficiency of brakemen, together with uncertain and varying conditions have, on previous occasions, caused many wrecks. A simple scheme was therefore devised which provied an almost automatic and very efficient regulation of speed that was entirely reliable, inexpensive and simple, and prevented the occurrence of any accidents during the progress of the work.

The cars were hauled by the tractor in both directions to the top of the long grades between which the central station at Pecan siding was located. At the tops of these grades they were hauled by the gasoline locomotives over grades up to 6 per cent, where the locomotive brakes were entirely inadequate to handle the trains. The locomotives were therefore supplemented by retarding shoes placed on the forward ends of the trains or locomotives according to the direction in which they were operating. The brake shoe consisted of a steel cradle with two ⅜x 1½-inch flat bars, 18 inches long with the forward end curved 90 degrees over a 6-inch radius, about fitting the circumference of the wheel. These shoes were connected together by a pair of transverse drop bars offset downward to clear the wheel flanges and spaced to maintain the shoes to the track gage so that one shoe would slide on each rail with the curved end forward. At the beginning of a downgrade, the engine driver dropped the cradle on the track in front of the forward car and the front wheels, immediately riding onto the shoe, coasted down the incline without wear or injury, and reduced the speed of the train so that it could be easily handled by the locomotive while the train descended by gravity. On very light grades the shoes, of course, were not needed because they would entirely stop the train. The cradles were made by the blacksmith at a very small cost and were entirely successful in preventing all accidents due to grades. They were not, however, required or used on the steepest slopes, where the trains were moved up and down by tractor hauling and were controlled as before described by a trailing safety device, of which ten or a dozen were provided and always kept in readiness at the incline. By this system, an economy in brakemen was effected and the flattening of wheels by locking was eliminated.

CONCRETING

The gang working at and around the concrete machine averaged about twelve men and under favorable conditions laid up to 460 linear feet of pavement in a 10-hour day. The road forms, of the heavy type of the Heltzel Steel Form and Iron Co., were mounted on pedestals and gave excellent satisfaction. A force of three men were required for setting and adjusting them, moving them forward, cleaning and resetting them, and kept them at a minimum of about 1,000 feet in advance of the concrete mixer.

The concrete was mixed in an Austin cube paving machine at an average rate of about 250 batches per 10-hour day and at a maximum rate of 300 batches in one 10-hour day. The concrete was finished by a Lakewood machine, which was used throughout, including the long-radius curves. Expansion joints ½-inch thick were made of Carey roofing felt and placed at all points of curvature and points of tangency of both vertical and horizontal curves as well as at the end of the day's work. The forms were generally advanced in 200-foot lengths which were removed, oiled, cleaned and piled on the finished concrete until convenient to carry them forward on the batch box cars.

The finished concrete was protected with transverse strips of 72-inch burlap that was applied as soon as the surface was finished. It was kept wet for 24 hours and then removed and replaced by straw which was kept wet for about 14 days. No dirt whatever was used for protection.

The work was executed by an average force of about 110 men under the direction of W. E. German, superintendent; Mr. Mason, chief inspector, and Mr. Buckius, district engineer. Concreting was commenced in August, 1921, and will probably be finished by October, 1922, about 45 per cent of the work having been completed before it was suspended for the winter months. Common labor received about 35 cents and skilled labor up to 80 cents per hour, making an average payroll of about $7,000 per month.

The equipment used on the job included three Buffalo Springfield rollers, each provided with a scarifier; one 18-ton Erie shovel, seven 10-ton Holt tractors (two for excavation and five for concrete); one Austin cube mixer 21E with automatic water tank, boom and bucket, unloading derrick and caterpillar traction; one Lakewood sub-grader; fifty Koppel cars fitted with two five-bag batch boxes with separate cement container and cover; 3,000 lineal feet of the heavy type of Heltzel road forms mounted on pedestals; one Ohio locomotive crane, one 3-ton Whitcomb yard locomotive, five 7-ton Government Baldwin-Whitcomb hauling locomotives and one Ingersoll-Rand "Imperial" air compressor.

Refuse Collection in Washington

The report of the Engineer Department of the District of Columbia, for the year ending June 30, 1921, of which department Col. Charles W. Kutz is engineer commissioner, states that for that fiscal year the operations of the city refuse division were covered by two appropriations; one of $375,000 for dust prevention, cleaning of streets and alleys and snow removal and the second of $750,000 for the collection and disposal of refuse.

The department collected 60,058 tons of garbage, an amount greater than ever before collected, at a cost of $244,440. The revenue from grease and tankage produced from this garbage at the reduction plant was $155,197, while the cost of operating the plant was $196,163. The sum received from grease and tankage was smaller than during the two previous years because of the unprecedentedly low prices prevailing for such products. After April, 1921, the price offered for tankage did not equal the cost of production and the tankage cakes were simply piled up and not sold.

Because of the mild winter, the amount of ashes collected was only 133,940 cubic yards as compared with 148,228 cubic yards the previous year.

In 1920 the contractor for operating the salvage plant failed and this work was taken over by the

district until the termination of the contract on June 30, 1921. During the operation by the district the revenue from the salvaged material amounted to slightly more than the cost of operating the plant.

During the three years prior to the writing of the report, the district had taken over as municipal functions the collection and disposal of the three classes of refuse—garbage, ashes and trash. It therefore seemed necessary, in the opinion of Col. Kutz, that the department secure a stable in the suburbs, repair shop, garage for trucks; that the present garbage reduction plant be overhauled and remodeled and an up-to-date trash plant be constructed with an incinerator of large capacity located in the industrial section along the railroad; and also that the district obtain property outside of its limits for dumping purposes.

Washington Municipal Asphalt Plant

Amount of work done, cost of the various operations and unit cost of asphalt mixtures

The total output of the municipal asphalt plant of the District of Columbia for the year ending June 30, 1921, comprised 195,336 cubic feet of old material mixture, 3,624 cubic feet of asphaltic concrete mixture and 16,872 cubic feet of topping mixture. The plant was operated for 248 days with an average daily output of 870 cubic feet. The crusher was operated 76 days and crushed 4,302 cubic yards of old material hauled to the plant from various streets.

Pains were taken to keep both the plant and the crusher constantly in a good state of repair and the best possible operating condition. The cost of maintenance and repairs is included in the following cost of producing materials.

For operating the crusher and mixer there were used 28,612 gallons of fuel oil at an average cost of 10.1 cents per gallon, 196 tons of coal at an average cost of $9.25, and 76 cords of wood at an average cost of $19.80.

The operation of the crusher for 76 working days during the year totaled $6,549 for labor and fuel, or $1.52 per cubic yard. Maintenance, renewals and repairs cost $556 or 12.9 cents per cublic yard. For calculating overhead cost the original cost was amortized by reducing 20% each year during the first five years of its life. The total cost of material crushed averaged $1.649 per cubic yard.

The 248 days of operation of the asphalt plant involved an expenditure of $14,678 for labor, $2,986 for fuel oil, $1,651 for coal and $863 for wood; this giving a total cost of 9.34 cents per cublic foot for the asphaltic product. Hauling from the plant to the street cost 8.46 cents per cubic foot. On the street, labor cost 25 cents per cubic foot, pointing joints 0.45 cents per cubic foot and wood 0.30 cents per cubic foot; a total of 25.75 cents per cubic foot. Maintenance and repairs at the plant cost 0.89 cents per cubic foot and on the street 0.11 cents per cubic foot. Supervision cost 3.55 cents per cubic foot. This gives a total manufacturing cost of 48.10 cents per cubic foot.

Sand was bought under contract at 84 cents per cubic yard and hauled from the wharf to the plant at a cost of 37 cents per cubic yard.

COST OF MIXTURES.

From the above and combining the other items, the cost of a cubic foot of old material mixture was calculated as follows: 0.65 cubic foot of old material at $1.65 per cubic yard, 3.97 cents; 0.35 cubic foot of sand at $1.21 per cubic yard, $2.60 cents; 3.12 pounds of limestone dust at $4.40 per ton, 0.69 cents; 4.58 pounds of asphaltic cement at $24.61 per ton, 5.63 cents. This gives a total cost for material of 12.89 cents per cubic foot. Adding this to the manufacturing and placing cost of 48.10 cents, gives a total cost per cubic foot of 60.99 cents.

Asphaltic concrete mixture consisted of 0.5 cubic foot of screenings at $2.60 a ton, 0.5 cubic foot of sand, 4.2 pounds of limestone dust and 9.16 pounds of asphaltic cement, all at prices given above, giving a total cost for material of 22.52 cents. Adding this to the manufacturing and placing cost gives a total cost per cubic foot for new asphaltic concrete mixture of 70.62 cents per cubic foot.

Topping mixture cost 67.71 cents per cubic foot, consisting of one cubic foot of sand, 4.20 pounds of limestone dust, 9.16 pounds of asphaltic cement, giving a total cost for materials of 19.61 cents, to which is added the same manufacturing and placing cost as above.

PAVEMENTS NOT UNDER GUARANTEE.

The amount of asphalt streets not under guarantee by contractors totaled 3,253,588 yds. The total cost of minor repairs to these pavements during the year was $122,142, giving a cost per square yard for maintenance of 3.75 cents. Maintenance costs similarly calculated for former years, from the year 1908 to date, were as follows: 3.8 cents, 2.3 cents, 2.6 cents, 2.2 cents, 2.4 cents, 2.0 cents, 1.9 cents, 1.9 cents, 1.8 cents, 1.5 cents, 1.7 cents, 3.07 cents, 3.38 cents. "The marked reduction for the year 1917 is affected very significantly by the law effective that year by which repairs to pavements over one year old are chargeable to repair appropriations instead of being paid for by the paving contractors under a five-year guaranty as formerly. The yardage of pavement over which our repairs were distributed was thus increased by nearly 700,000 square yards, on which practically no expenditures were needed, as the pavements were only from one to five years old."

"In connection with these costs of annual repair it should be considered that some of the streets approximate an age of 40 years and that the average age of those we have resurfaced in recent past years exceeds 25 years. The average age of streets resurfaced in 1910 was 25.8 years; in 1911, was 24.5 years; in 1912, was 25.8 years; in 1913, was 26 years; in 1914, was 28.5 years; in 1915, was 28 years; in 1916, was 29.6 years; in 1917, was 27 years; in 1918, was 26 years; in 1919, was 26.7 years, in 1920, was 23.6 years; in 1921, was 23.2 years."

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Maintenance of Roads

A neglected road, like a neglected automobile or other piece of machinery, after a short time begins to deteriorate rapidly unless it is properly and continuously maintained. Most states have come to realize this already; some, however, not until they have seen some of their roads go entirely to pieces because of neglect.

As the mileage of paved roads multiplies, the cost of upkeep increases, while the cost of constructing new roads decreases, until maintenance cost exceeds construction cost. Many counties are appropriating for maintenance this year sums that would have seemed enormous for construction a few years ago. Oakland county, Michigan, spent $282,487 for maintenance last year and has $300,000 available for this year; while $200,000 is available by Montgomery county, Alabama, Sacramento county, California; Oswego county, New York; Hancock county, Ohio, and others.

In last week's issue of *Public Works* we gave the figures of last year's expenditures and this year's appropriations for maintenance by several hundred counties. This year's appropriation averaged $45,560 per county, and as these reports were obtained from counties in nearly all the states, this may be assumed to be the average for all the counties of the country. Some states will, of course, average higher, some lower. For example, 48 of the 99 counties of Iowa average $49,200 or an indicated total of nearly $5,000,000 for this state alone.

There are in the country 3,013 counties, and if we use the above average as applying to all of them, we have a total for the United States of $137,272,280 available for maintenance this year, and approximately that amount was spent for that purpose in 1921.

For maintenance, different states and counties use different appliances, as shown in one of the tables in last week's issue. In most cases the states have studied carefully the local needs and helped the counties to select the methods and appliances best suited to their own kinds of roads, soil, climate, local materials, finances, etc. Trucks, drags, scrapers, scarifiers, plows, rollers, asphalt kettles, are among the larger pieces of apparatus used; while probably all counties supply their maintenance forces with hand tools, wheelbarrows and the like. In fact, considering that maintenance covers the entire state while construction is in spots only, road maintenance probably requires a larger total equipment than does road construction.

Income From Refuse Disposal

An article elsewhere in this issue gives in abstract the opinions of an English and a Canadian in reference to the matter of disposing of municipal wastes, each referring to the income obtainable in connection therewith. One of these, speaking before a Canadian society, advocates the utilization of garbage for its fuel value, stating that the heat generated can be used for power production when at least 40 tons of garbage per 10 hours is available. The English engineer, however, considered incineration to be uneconomical because it is difficult to utilize efficiently the fluctuating amount of steam. This writer seems to prefer disposal by dumping, by crushing or by salvaging, but admits that the two latter depend for their success upon the availability of suitable markets for the crushed refuse used as a fertilizer or for the materials salvaged.

This matter of finding a market for by-products or salvaged material has not been given sufficient consideration in the past. Even with the comparatively small amounts of material now being salvaged and of grease and tankage being obtained by reduction of garbage, the market does not at present seem able to absorb all of the material, grease is being sold for a small percentage of that received for it when reduction plants were few, and tankage can find no market at all at present.

In all of these methods in which the return of a part of the cost of operation and of interest on construction is expected from the sale of products or by-products, the saving thus anticipated is ordinarily calculated to be a comparatively small amount—so small that a not very considerable change in market conditions may easily change the profit into a deficit. When an appliance or method introduced for the purpose of deriving a profit from refuse disposal forms any considerable feature of a project, such project becomes largely one of manufacturing and should be considered as such, and should be under-

taken only under conditions which a manufacturer would consider as warranting his investment in a plant of similar cost.

Engineers' Plans for State Health Boards*

For what kinds of work and under what conditions it is necessary to file plans for water works and sewerage systems in the several states

Alabama.—Petition for permission and complete plans and specifications and a general description of any proposed water supply system or changes in an existing system must be filed with the state board of health; not including, however, mere extensions of the distribution system. This procedure is not required if water is to be furnished solely for use on private property where there is no industrial camp, hotel or resort, or if less than 50 persons are to be supplied. The board must then investigate the suitability of the proposed supply. There is no similar law relative to sewerage, but cities rarely accept plans and specifications from engineers without their first having been examined by the state board.

Colorado.—There is no general statute that requires the submitting of reports or plans for sewerage and water works, but it is the custom of engineers to submit such plans to the state board of health.

Georgia.—Cities or private companies, before installing a sewerage or water works system, including water purification plant, or making any change in an existing water works system, must file plans and specifications with the state board of health.

Indiana.—There is not any legislation requiring submitting plans of either sewerage or water works systems, but municipalities are asked to consult the board on such plans for their own protection and advantage.

Minnesota.—Complete plans and specifications of any system of water supply, sewerage, or refuse disposal for public use, which affects or tends to affect public health, or material alterations or extensions, must be approved before being installed. The courts have held that contracts for such work are void unless the plans have been approved by the state board of health.

New York. The New York procedure is the most complicated in the country, in that the jurisdiction is divided between three departments. Plans for sewerage systems and sewage disposal plants must be approved by the Bureau of Sanitary Engineering of the Department of State Engineer and Surveyor, while permits for discharge of sewage into the waters of the state must be obtained from the Bureau of Sanitation of the State Department of Health. Plans for water supply systems must be approved by the Water Power Commission. Approval must be had not only for original construction but for modification or extension of municipal sewers and sewage disposal works; also for extending the water mains of a municipality outside of its own limits, or those of a water company outside of the limits of the original franchise. Approval also must be had of the acquisition or condemnation of an existing water works system or any part thereof.

North Carolina. The law requires any municipality or corporation intending to build water works or sewerage system to consult with the state board of health in regard to the best source of supply for water or place and best methods of sewage disposal; also that plans and specifications be approved by the state board of health before contract for construction can be entered into, which contract would be null and void without such approval.

North Dakota. Plans for a system of water supply, sewerage or refuse disposal for public use in the state, which affects or tends to affect public health, must be approved before the system is installed, altered or extended.

Ohio. Plans must be approved by the State Department of Health for proposed public water supplies, purification plants or changes or extensions of the same; or for public sewerage systems or sewage treatment plants or changes in the same, designed for incorporated municipalities or communities, county sewer districts or other lands in a county outside of incorporated municipalities, where either water supply or sewerage is to be used for the service of three or more dwellings or other buildings. The same also applies to plants for county, district or other public institutions, privately-owned institutions, colleges, clubs, factories and other public, quasi-public or privately-owned buildings and places used for assemblage or employment of persons.

Oklahoma. Plans must be filed and a written permit obtained from the State Board of Health before letting a contract for constructing or doing any construction work for supplying water for domestic purposes to the public by means of a water works, this, however, not applying to extensions of water mains. The same is required for a system of sanitary sewerage or sewage treatment or any extensions thereof.

Pennsylvania.—State laws prohibit the construction of a waterworks without a written permit of the commissioner of health, application for which must be accompanied by plans. For mere extensions of distribution system, plan must be filed after construction, before close of calendar year. Approval of plans for dams must be obtained from State Water Supply Commission, which passes on their structural stability. Plans for sewerage systems or sewage treatment works and extensions must be approved by the state department of health.

Rhode Island. Plans and permits for water systems are not required, the State Board of Health having no authority to compel any water works to follow its advice. It examines plans and offers advice when requested, which frequently happens. As to sewers, the law does not specifically require the approval of plans, but the Board of Purification of Waters can order discharge of sewage or operation of sewage treatment plants discontinued, and it is

*Continued from page 238.

therefore to the advantage of communities and engineers to have their plans approved beforehand. The sanitary engineer of the State Board of Health also acts as sanitary engineer for the Board of Purification of Waters in this connection.

South Dakota. The Department of Sanitary Engineering was established last November and at the time of sending us information had no regulations or legislation providing for the approval of plants. It was hoped, however, that such regulations and legislation would be adopted and put into force very soon. The board hopes that these will provide for submission and approval of complete plans for sewer systems and water supply works.

Tennessee. Plans must be approved by the State Board of Health for new or proposed water supply and sewerage systems or changes in existing works, before construction can be begun.

Texas. Plans of water supply and purification works and for sewerage and sewage treatment systems must be submitted.

Virginia. Maps, plans and specifications must be filed with state board of health, and permit be obtained from board, before supplying water for drinking or domestic purposes to the public, or before changing or enlarging system, except the distribution system.

Washington. Approval of the State Board of Health is required of plans for a new system or changes or extensions of an existing system or for the disposal of waste products, where such system is for the use of "more than 5 families or 50 persons;" also for a new water supply or change or extensions to an old supply for drinking or culinary purposes or for use in swimming pools, where such supply is "for any number of persons exceeding 10 families or a total of 50 persons." (Probably the sewerage requirements also should have named 10 families rather than 5.)

West Virginia. Plans must be approved by the State Health Commissioner for any system of drainage, sewerage or water supply before construction begins. This work is in charge of the division of sanitary engineering of the Department of Health.

Wisconsin. Approval of the State Board of Health must be had before commencing construction of plants for new water supplies or extensions or alterations in the source, pumping equipment, purification plant, storage or any other part of the system which may in any way affect the quality or quantity of water in existing water works. Also approval must be had of plans for sewerage systems or alterations to existing systems or sewage disposal plants which may materially affect the quantity and quality of the effluent; also for refuse disposal plants or material modifications of existing plants.

Wyoming. Petition for permission and plans for a water supply system for domestic use must be filed with state board of health. This applies to alterations and extensions, but does not apply if water is to be used by the party himself on property where there is no industrial camp, hotel or resort, or when it is to supply less than 50 service connections, unless a formal complaint is filed.

Petition and plans are required for constructing a system or works for discharging sewage into any stream or other water used or intended to be used for human consumption or for domestic purposes or which may discharge into such water, or for maintaining a sewer farm or sewage treatment works; or for extending or altering any such system or works.

Proposed Reservoir for Boston's Supply

Reservoir to serve the Metropolitan district to cover thirty-nine square miles and cost sixty million dollars, recommended by Engineer Goodnough

The chief engineer of the Joint Board of the State Department of Health and the Metropolitan Water and Sewerage Board, X. H. Goodnough, has recently submitted a report to this board, and the board has submitted it to the legislature, which would call for the construction of a reservoir 17 miles long and 4 miles in greatest width with a capacity of 400,000 million gallons and estimated to cost $60,000,000. This reservoir would supply the needs of the municipalities in the Metropolitan district and of others within a radius of ten miles of Boston. The reservoir would cover the sites of Enfield, Greenwich and Prescott and part of the populated area of Bana, the total area covered being about 39 square miles.

While no specific recommendation is made for immediately starting this project, it is calculated that the present supply will be exhausted by 1935 or at least by 1938. The engineers estimate that it will require twelve to fourteen years to complete the reservoir.

At the point selected for the dam, the boundary between Enfield and Ware, the bed rock is covered with a deep deposit of drift, which is porous and water bearing and cannot be made impervious to water. Consequently it will be necessary to carry construction through this material to bed rock. The plans propose a core wall of impervious material to bed rock, which at its deepest point is 145 feet below the present brook bed, the dam itself being made of earth. At the westerly end of the dam a spillway and discharge channel will be constructed in rock, the discharge channel emptying into the river through an outlet channel well below the dam.

A dike will be necessary in the valley of Beaver Brook to confine the waters of the reservoir. The same difficulty was experienced in locating a favorable site for this dike, since the material at the low point in the land immediately surrounding the reservoir is very porous. Consequently, a site was selected about a mile south of the divide and here also a water-tight core wall carried down to rock will be required.

Some of the features of the dam are as follows: The flow line will be 147 feet above the present surface of the river, or 253 feet above the bottom of the rock gorge. The width of the rock gorge at the flow line is 2,700 feet. The dam itself will rise 18

feet above the flow line and have a top width of 36 feet.

At the Beaver Brook dike the flow line will be 115 feet above the brook and the top of the dam 260 feet above the rock gorge, while the length of this dam at the flow line will be 2,150 feet. It also will rise 18 feet above the flow line and have a top width of 36 feet.

The upstream slopes of both dam and dike will be somewhat flatter than 1 to 3 and the downstream slopes somewhat flatter than 2.5.

The drainage area is 186 square miles, and the storage capacity of the proposed reservoir would seem to be disproportionately large were it not for the fact that the plan contemplates the storage in this reservoir not only of the water of the Swift river, but also that from large areas in the water sheds of the Ware and Millers rivers, together with a possible subsequent extension to the Deerfield river, and even other areas may be added if future necessities should demand.

The proposed reservoir would flood 15.9 miles of railroads and 106 miles of highways. It would contain a number of islands which are rocky and for the most part covered with forest at the present time. It would be necessary, in order to protect the purity of the water, to acquire all of these islands and also the land about the margin of the reservoir in order to prevent uses of the reservoir which might be objectionable. It will be necessary for about 2,000 persons to remove from the area acquired, in addition to which there are 14 mills, 38 stores, 6 churches, 13 houses, 2 public buildings, 14 railroad stations, freight houses, etc., 463 occupied houses and 30 vacant houses, 381 barns in use and 18 vacant and 61 camps and summer cottages.

The soil seems to be favorable to use as a reservoir. The greater part of it is sandy plains covered with brush and having a very thin surface layer of loam. Swamps containing peat are exceedingly rare, totaling less than 700 acres. The engineers do not advise removing the surface soil, but only the bushes and trees. It is suggested as possible that over large areas the surface soil itself can be largely reduced to ashes.

Chlorination and Water-Borne Disease

An article discussing the relation between bacillus welchii and water-borne diseases and an editorial on the same appeared in the January 28th issue of the Journal of the American Medical Association. The former was by Herbert B. Larner, health officer of Montclair, N. J. In this article Mr. Larner expresses the belief that great sanitary significance should be attached to the presence of B-welchii in public water supplies because (1) During the gastro-intestinal outbreaks in Montclair in 1918 and 1921 anaerobic bacteria similar to B-welchii were found in the public water supply and in clinical findings in the cases of sick persons in the 1921 outbreak, while no typhoid cases occurred; the water supply in each case being suspected as the cause of the wide-spread outbreak; and (2) intestinal disease outbreaks such as occurred in Cambridge, Mass., in 1920 are believed by prominent sanitarians "as due possibly to heavy infection of water with B-welchii."

(In this connection it might be noted that the 1918 outbreak in Montclair was confined to this and to possibly one or two other communities out of a large number which were served by water that was derived from the same source and treated in every way similarly up to the point where it entered the mains. This case was discussed in Public Works and other technical papers at the time.)

In discussing this, the editor of the Journal of the American Medical Association states that the evidence available at present is quite inadequate for a scientific decision as to whether the ordinary B-coli test for water contamination is sufficient. He states that the nature and classification of the anaerobic organisms in water, the spores of which are not killed by chlorine (the so-called "stormy fermenters") still remain to be determined; it has not been shown definitely that these anaerobes in water supplies are B-welchii, and it has not been shown conclusively that the B-welchii organisms in water supplies are the cause of gastro-intestinal disturbances.

Incineration of Garbage

In discussing this, R. R. Knight, in a recent paper before a Canadian society, stressed the desirability of utilizing the fuel value of garbage—about one-fourth of the calorific value of poor coal—to bring about its own destruction. An average of one-fifth ton of garbage per capita per annum can be expected from a large community, and 1 lb. of garbage can be considered capable of evaporating 1 lb. of water in addition to the three-fourths lb. contained in the garbage. The heat generated can be used for power production, but, for this purpose, at least 40 tons of garbage per ten hours should be available. Incineration of garbage without the use of added fuel is considered impracticable for cities of less than 15,000 people. There should be no nuisance from a well-managed incineration plant. An incinerator for a city of 20,000 people should cost approximately $30,000.

The same subject was discussed by James Gair before the Royal Sanitary Institute (England), in which he claimed that the destruction of refuse by fire is not considered economical because (1) 40% of the refuse is incombustible; (2) the method is unreliable and irregular as regards steam raising capacity, making difficult the problem of utilizing efficiently the fluctuating amount of steam; (3) it involves a heavy working cost; and (4) it involves a high initial outlay.

He stated that an analysis of house refuse, especially in London, showed the chief constituents to be practically uniform. As a fair and general average, the writer stated that in every 100 pounds of refuse the component parts in pounds are: coal, 0.35; coke, 0.15; bones and offal, 0.37; breeze and cinder, 25.55; rags, 0.40; paper, straw, fibrous material and vegetables, 13.15; ash, 47.00; dust and dirt, 9.75; bottles, 0.48; metals, including tins, 0.68; crockery, 1.72; glass, 0.37. He estimated that only 60% of the above is combustible; that two-thirds of the total bulk will pass through a 2-inch ring; and that the calorific value of refuse is about 20-25% of the value of good steam coal.

Mr. Gair stated further, in reference to other

methods of disposal, that disposal by dumping, if carried out under careful supervision would result in the filling in of low areas without insanitary nuisance.

Disposal by pulverizing or crushing to prepare the refuse for use as fertilizer depends for its success upon (1) preliminary sorting of material in insoluble form; and (2) availability of suitable markets.

Disposal by salvage consists of passing the refuse over mechanically operated screens; sorting the salable waste; burning unsalable waste to produce steam for driving the screens; washing the screened waste to obtain a low grade fuel of uniform quality; and disposing of the fine ash and dust as a fertilizer after grinding to a powder. The success of a salvage plant depends upon availability of a suitable market for the materials saved.

New Imhoff Tank

New patent taken out by Dr. Imhoff for securing odorless decomposition by continuously mixing fresh sewage with decomposing sludge

A new patent has been taken out in this country by Dr. Karl Imhoff, having been granted on December 6th, 1921 to Dr. Imhoff and Heinrich Blunk, both residents of Essen on the Ruhr. This tank is entirely different in action from the one known in this country as the Imhoff tank, although in one form it bears considerable structural resemblance to it.

In the specifications of the patent (which is No. 1,399,561), Dr. Imhoff says that "to a certain extent, and under certain conditions, it is possible to obtain in the so-called Imhoff tank (a combination of sedimentation and decomposition chambers) a fairly odorless and a fairly rapid decomposition. All attempts have been in vain, however, to attain this rapid and odorless decomposition in ordinary sludge containers of any kind, when charged with sludge in the usual manner."

"When sewage material such as putrescible sludge, which usually has a high moisture content, or municipal sewage, which is also included under the term sewage material, is allowed to remain for some time in a container, various kinds of decomposition are taking place. The two most important classes of decomposition which take place may be termed putrid decomposition, which is characterized by the evolution of hydrogen sulphide and other bad smelling gases, and odorless decomposition, in which practically only odorless gases (mainly marsh gas and carbon dioxide) are evolved."

Dr. Imhoff says that the difficulty in securing odorless decomposition in ordinary sudge containers is due to failure "to promote odorless decomposition, which begins to take place in deposited sludge in a certain time, to a sufficient extent by the addition of food in the form of fresh sludge. Another reason is that it has been neglected to permeate the fresh sludge sufficiently early with the exciters of odorless decomposition so as to prevent the occurrence of putrid decomposition.

"Both errors may be avoided when in a ripened decomposition chamber a continuous and intimate contact between fresh and decomposed sludge is secured." The aim of this patent of Dr. Imhoff is to secure this mixing of fresh and decomposed sludge, which process is applicable not only to ordinary sludge containers but will "accelerate decomposition in Imhoff tanks."

The patent suggests two types of apparatus for performing this intimate mixing. In one of them fresh sludge is drawn from a sedimentation tank and decomposed sludge from a digesting tank, the two being discharged simultaneously into and through a pipe, which in turn discharges them into the digesting tank. Part of the digested sludge is discharged from time to time onto sludge beds, while the displaced supernatent liquid in this tank passes out through an overflow into the sedimentation tank.

In the other type of apparatus the fresh sludge is pumped into an equalizing chamber, from which it is discharged as desired into a sludge digesting tank which is provided with an upper and lower chamber separated by inclined slabs and a "V"-shaped gas deflector as in the ordinary Imhoff tank. Other deflector plates are placed below the gas deflector with a view to concentrating the rising of the bubbles to a point where they can effect a rapid mixing of the incoming with the decomposed sludge. Also compressed air is forced in through a pipe in the bottom of the lower compartment, to agitate the sludge and assist in mixing the decomposed sludge in the bottom of the tank with the constantly incoming fresh sludge.

There are eleven claims in the patent, but all of them are process claims rather than apparatus claims, there being no apparatus claim whatever. As is customary in endeavoring to cover every phase of a process, these eleven claims are made to cover every possible combination of "bringing decomposing sludge into intimate contact with fresh sludge" either simultaneously or successively, or mixing decomposing sewage material with fresh sewage material, or decomposing sludge with fresh sewage material, or fresh sewage material with decomposing sewage material or fresh sewage material with decomposing sludge.

Without having thoroughly investigated the subject, it seems to us that the mixing of fresh and digested sludge in order to secure a better character of sludge from a sewage plant is by no means novel but has been employed to a greater or less extent by many operators of Imhoff tanks, and there naturally arises the question whether this simple process is subject to patenting. The application for this patent was filed April 19, 1913, or nearly nine years ago, and it is possible that prior to that date, no deliberate mixing of raw and of undigested sludge had been practiced in this country.

It might be well for engineers who have been operating sewage treatment plants for a number of years to give careful consideration to this point and consult some of their past records with a view to having data on this point available for legal purposes.

Recent Legal Decisions

ILLINOIS DEPARTMENT OF PUBLIC WORKS HAS OPTION TO TAKE LAND AUTHORIZED FOR ROADS

The Illinois Supreme Court holds, Department of Public Works and Buildings v. Caldwell, 133 N. E. 642, that in a proceeding by the department to acquire a right of way for a state-wide system of hard roads, under Illinois Laws 1917, p. 707, § 11, a judgment which provides that, upon payment of the compensation ordered, the department is "authorized to enter upon and take possession of and use for the right of way purposes" the tracts of land so taken, is not subject to the objection that this gives the state an option to take the land, and that it should be ordered to take the land, since the State has a right to abandon the location and to refuse to pay the damages ascertained.

PUBLICATION OF NOTICE FOR BIDS FOR PAVING CONTRACT HELD MANDATORY

The Washington Supreme Court holds, Wyant v. Independent Asphalt Paving Co., 203 Pac. 961, that the state statute, Rem. Code 1915, § 5755, providing that notice inviting bids on a local highway improvement "shall be published for at least two consecutive weeks previous to the date of letting, in one or more daily or weekly papers published and of general circulation in the county, and in such other manner as the board may see fit to direct," was not complied with by publications on January 25th and February 1st, when the bids were considered and the contract was awarded on February 7th, since two weeks had not elapsed between the date of the first publication and the date of letting the contract. The court holds the provision of the statute, so far as the publication of the notice for two weeks is concerned, is mandatory and injunctive relief would be granted against proceeding with the contract if sought with a fair degree of promptness. If the sufficiency of the publication was not challenged until after the completion of the improvement, owners objecting might be held estopped by delay.

ZONING PLAN FOR PAVING ASSESSMENT PRESUMED PROPER IN ABSENCE OF EVIDENCE TO CONTRARY

A city council, as a board of equalization, adopted the zone plan for the apportionment of assessments, so that all property in the district within the zone nearer to the paving was assessed a higher per cent. of the tax, and the zone next further removed a medium per cent. and so on, reducing the amount by zones until the property in the farthest zone was required to pay the least proportionate part. Where no evidence was introduced by complaining property owners, in proceedings to review an order of the council fixing paving assessments, which would show that the assessment was not in accordance with nor in excess of benefits, the Nebraska Supreme Court, Broghamer v. City of Chadron, 186 N. W. 362, presumed that the plan adopted was a proper one. The board of equalization was entitled to a fair opportunity while it was in session to avoid error and to meet objections to the propriety of the plan of apportionment of the tax and the necessity of the expenditure.

ADOPTION OF CITY STREET AS HIGHWAY BY STATE OR COUNTY HELD NOT TO RELIEVE CITY FROM KEEPING IT SAFE FOR TRAVEL

When the Legislature creates a municipal corporation and grants it power to open, grade and maintain public streets within its corporate limits, the West Virginia Supreme Court of Appeals holds, City of McMechen vs. Wheeling Traction Co., 110 S. E. 469, that such parts of a public highway as may be within such corporate limits as are adopted by said municipal corporation as one of the streets thereof become a public street of such city, and the primary obligation to maintain the same in a reasonably safe condition for travel is, upon the municipal corporation, and not upon the county court of the county wherein such municipal corporation is situated. And where under the provisions of the state road law the county or state authorities adopt a city street, or any part thereof, as a part of one of the highways of the state or county, the city in which such street is is not relieved of the duty and obligation to maintain the same in a reasonably safe condition. The effect of each adoption of such a street by the state or county authorities as a part of a main state or county road is held to be simply to enable the state or county authorities to spend the state or county funds thereon to make it reasonably correspond in its condition with the highway or highways with which it connects at the corporate limits of the city.

CONSTRUCTION AND REPAIR OF ROADS A GOVERNMENTAL FUNCTION—NEGLIGENT DRIVING OF REPAIR TRUCK

The West Virginia Supreme Court of Appeals holds, Douglas vs. Rodue County Court, 110 S. E. 439, that the construction, maintenance and repair of public roads of a county by its county court are governmental functions; therefore such court is not liable for an injury inflicted upon a citizen by the negligence of its agent, servant or employee in the execution of such work, unless the act causing the injury was of such character as to impose liability under the provisions of a statute. The negligent driving of a motor truck owned by a county court and used in repairing roads does not make the road unsafe for travel or "out of repair" within the meaning of section 154, chapter 43, Code Supp. 1918, and the county court is not liable for the death of horseman thrown when his horse took fright at the truck.

COUNTY CANNOT PAY MORE THAN CONTRACT PRICE OF ROAD CONTRACT

The Commissioners' Court of a county in Texas entered into a road contract to be performed according to specifications for the sum of $15,000. The Circuit Court of Appeals hold, Gray County vs. Hamer, 277 Fed. 155, that, under article 3, section 53, of the state constitution, providing that the legislature shall have no power to authorize counties or municipal authorities to grant extra compensation to contractors after service has been rendered or a contract has been entered into and performed in whole or in part, where no more work has been done than that specified in the contract, the county cannot afterwards allow a further payment.

NEWS OF THE SOCIETIES

CALENDAR

Apr. 20—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Meeting called by committee of organization at Hotel Commodore, New York. General secretary, W. S. Hays, Drexel Building, Philadelphia.

Apr. 25-28—BUILDING OFFICIALS' CONFERENCE. Annual meeting. Hotel Lincoln, Indianapolis, Ind.

Apr. 26-28—SOCIETY OF INDUSTRIAL ENGINEERS. National spring convention. Detroit, Mich.

Apr. 27-29—BUILDING OFFICIALS' CONFERENCE. April 27-28, Clevland, O.; April 28, Massillon, O.; April 30, Youngstown, O.

Apr. 29—DETROIT ENGINEERING SOCIETY. Hotel Cadillac, Detroit, Mich.

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 9-11—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. Atlantic City, N. J.

May 12 — NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE, Bear Mountain Inn, Pallsades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines, Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Hadden Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Clevland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES CONFERENCE

This conference, held in Chicago, April 3, 4 and 5, was attended by a large number of realtors, bankers, insurance men, architects, engineers, builders, contractors, sub-contractors, materials and equipment producers and distributors, publishers and others from all parts of the country.

Discussions, intended to secure complete presentation of the subjects from every standpoint, were led by men of national prominence, and included the following principal topics: I—How trade associations can be made more effective; II—(Tuesday, April 4th)—Capital must be economically mobilized for construction and home building. How to provide capital for construction in periods of depression. III—Efficient workers needed to meet country's enormous construction program. Co-operation between employers, employees and educational authorities must develop sound apprenticeship systems and trade schools for building trades. IV—Handicaps to be overcome in reducing cost of construction. V—Can homes be built which workers can afford to live in? VI—Proper development of municipal building, highway, fire prevention and other inspection bureaus. VII—Progress industry has made in design, distribution, production, research, standardization, transportation and utilization of materials, and elimination of waste an inspiration to greater effort. VIII—What must the industry do to relieve the housing shortage? IX—The present situation in the agricultural industry. X—Community Construction Conferences. XI—Can construction be made less seasonal? XII—Promotion of greatest development of the combined industry.

Besides the regular sessions and time devoted to the inspection of exhibits there were several special luncheons and dinners, and a construction Gridiron Club Affair Tuesday evening April 4, all at the Drake Hotel.

A special luncheon meeting Wednesday noon, April 5, was held of Secretary Hoover's Committee on Construction Development with the officers of the leading national associations.

The sessions concluded with a dinner at the Congress Hotel, April 5. This construction industries dinner was the occasion also of a dinner for the Fourth American Lumber Congress, which opened on that day.

ROCHESTER ENGINEERING SOCIETY

At the special meeting, March 31, "Pioneer Inventions and Pioneer Patents" were discussed by Frank Keiper, patent attorney, who talked on widely used inventions that are known to everyone and the patents and claims on these inventions. His list included the Howe sewing machine patent, Morse telegraph patent, Goodyear's patent on vulcanizing rubber, Tilghmans patent on separating fats into fatty acid and glycerine, Bell's telephone patent, Edison's patents on the incandescent lamp and talking machine, etc. He referred to earlier great inventions that preceded the U. S. Patent System, and showed from these how the invention must be described and claimed, how mistakes are made in the taking out of patents, and the effect of them and the remedy. He discussed the history and litigation of these patents and brought out many of the fundamental principles of patent law in connection therewith.

BROOKLYN ENGINEERS' CLUB

The informal library meeting was addressed March 30 on "Helicopters and Soaring Flight, Without Motors" by Augustus Post, of the Aero Club of America. Mr. Post discussed the recent developments in helicopters which are now considered by many as a possible means of flight. He also discussed the very remarkable flights without motors recently made, and showed how the varying currents of air were used by the aviators.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular and joint meeting, April 14, the topic was: "Muscle Shoals as a Power and Nitrates Producer."

The subject of Muscle Shoals as a Power Producer was introduced by Brig.-Gen. Harry Taylor, Assistant Chief of Engineers, U. S. A.; Muscle Shoals as a Nitrates Producer was discussed by W. S. Landis, Chief Technologist, American Cyanamid Company, in its commercial aspect, and by Maj.-Gen. C. C. Williams, Chief of Ordnance, U. S. A., in its munitions aspect. Discussion was opened by Messrs. E. A. Yates, of Wood, Hulse and Yates Company, Engineers, and Francis E. Frothingham, of Coffin and Burr, Bankers. Motion pictures of the Muscle Shoals development were shown and explained by Mr. Theodore Nagel, Consulting Engineer.

The subject of the second Sub-Section group conference was "Structural Design and Details—the Responsibility of the Engineer." James E. Edwards, Assistant Chief Engineer of the American Bridge Company, presided.

SPRING MEETING AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Fine technical sessions and social events at Atlanta, May 8-11, preceded by visit to University of Virginia, May 5-6, and followed by inspection of textile plants at Greenville, S. C., May 12, of steel mills and foundries at Birmingham, May 12, and a visit to Muscle Shoals on May 13.

The mornings will be given over to the technical sessions, which will start at 9:30 a. m.

The Textile Division and the Machine Shop Practice Division have co-operated in two sessions, which will deal with textile machinery. The Materials Handling Division is presenting a paper on Material-Handling Equipment as Used in the Iron and Steel Industry. The Session on Fuels covers a wide range. The Manage-

ment Division will present two general papers which will open the discussion of management methods. The Session of the Power Division will be devoted to a consideration of hydroelectric power with special relation to some of the very important installations in the Southeast.

One of the most important sessions at the meeting will be that on Welding, which has been organized jointly by the Boiler Code Committee of the A. S. M. E. and the American Welding Society. The four papers for this Session on Welding are the first presentations of test data on the strength limits of pressure containers. The Muscle Shoals development in its relation to the nitrogen supply of the country is a matter that is attracting widespread attention at the present moment. The author of the paper on this subject was at one time Commanding Officer of the Nitrate Plant at Muscle Shoals and his statement of the facts will be awaited with keen interest.

The meetings in Atlanta will be held in the rooms of the Chamber of Commerce and the hotels which are centrally located. The Piedmont Hotel has been designated as headquarters and there will be found the registration bureau and the meeting rooms of the Council and committees. Simultaneous sessions will, however, require the use of other meeting rooms. The Atlanta meeting will be operated on the pay-as-you-go basis. The burden of the meeting is to be borne by the Society and by the members attending. In accord with this principle, and following the custom originated at the last Annual Meeting, a registration fee of $2.00 will be charged to members and their male guests. Ladies will be registered free.

At the Business Meeting of the Society, to be held on Monday afternoon, the proposed new Constitution of the Society will be presented for a first reading. It is an epoch-making document, for it is probably the simplest and most direct of any constitution of any engineering organization in the world. Other important items of business include the report of the Committee on Code of Ethics which has taken two years to prepare, and which has expanded to become a joint activity of several national societies.

SECTIONAL MEETINGS OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS

An all-day hydroelectric conference was held in Philadelphia on March 21. The co-operating bodies were the Engineers' Club and the Philadelphia Sections of the A. S. C. E., the A. I. E. E. and the A. S. M. E. The Power Division of the A. S. M. E. assisted in the preparation of the program. Frank H. Rogers presented a paper on the 55,000 hp. turbines for the Queenstown-Chippawa development. He was followed by Charles M. Allen, whose paper was entitled Salt Velocity Method of Measuring Water in Pipe Lines. The third paper, entitled The Correlation of Momentum and Energy Changes in Steady Flow with Varying Velocity and the Application of the Former to Problems of Unsteady Flow or Surges in Open Channels was presented by Raymond D. Johnson. The final paper of the afternoon was prepared jointly by H. Birchard Taylor and Lewis F. Moody.

At the second technical session the Queenstown-Chippawa power development, was treated from three separate points of view. H. G. Acres, chief hydraulic engineer of the Hydroelectric Power Commission of Ontario, spoke on the General Description of Structures and Construction Problems; Edgar R. J. Brandon, electrical engineer of the Commission, treated the electrical features and the general features of design were given by T. H. Hogg, assistant hydraulic engineer of the Commission.

The seventh joint meeting of the Associated Technical Societies of Detroit was held under the auspices of the Detroit Section, A. S. M. E., on Friday evening, March 17, at the Detroit Board of Commerce. The speaker of the evening was John L. Harper, who gave an interesting illustrated talk on Niagara Falls Power Development.

ASSOCIATED TECHNICAL SOCIETIES OF DETROIT

The founding of the Associated Technical Societies of Detroit in January, 1922, was the culmination of a movement begun in earnest six months previously for the affiliation of the architectural, engineering and other technical societies of Detroit. The following twelve societies formed the charter membership: Detroit Section, American Society of Civil Engineers; Detroit Chapter, American Association of Engineers; Michigan Chapter, American Society of Heating and Ventilating Engineers; Detroit Post, Society of American Military Engineers; Detroit Section, American Society of Mechanical Engineers; Detroit-Ann Arbor Section, American Institute of Electrical Engineers; American Institute of Chemical Engineers; Detroit Engineering Society; American Chemical Society and Detroit Chemists; Michigan Chapter, American Institute of Architects; Detroit Section, Michigan Society of Architects and Detroit Chapter, American Society for Steel Treating.

The officers elected for 1922 are: chairman, P. W. Keating; vice-chairman, A. A. Meyer, and secretary-treasurer, Walter R. Meier. The society will take an active interest in all matters wherein engineering, architectural and technical subjects are an important factor and will assist in furnishing definite and accurate information on contemplated public improvements or undertakings by the city of Detroit or the State of Michigan.

A joint meeting will be held once a month; and as the new association will schedule the meetings of all the technical societies, conflict of dates with member societies will not occur. Also a central office will be established for conducting the business of the several societies and the combined interests of the professional men of Detroit will be represented by this organization.

PERSONALS

Brennan, B. C., for the past eleven years city engineer of Kenosha, Wis., has retired to enter the contracting field.

Silcox, Harold, Elizabeth, N. J., has been appointed general supervisor of bridges and structures in the construction division of the state highway division.

Reid, John W., has been appointed city engineer of Detroit, Mich., after 22 years' service with the Detroit department of public works, and Joseph L. Barton has succeeded to Mr. Reid's position of grade separation engineer.

Spear, R. E., city engineer and assistant city manager of Ambridge, Pa., has resigned.

Harrington, D. E., assistant city engineer of Madison Wis., has resigned to enter the engineering and contracting business.

Barrow, R. W., has been chosen building inspector of Meriden, Conn., a position recently instituted.

Brush, F. C., of Westfield, N. J., has been appointed city engineer of Norwich, N. Y.

Jones, Paul S., has been appointed superintendent of Imperial Mutual Water Co. No. 1, in Imperial Valley, Cal.

Tucker, M. P., has been appointed superintendent of waterworks of Akron, Ohio.

Hart, Samuel, has been appointed deputy city engineer of Sacramento, Cal.

Barber, Walter, formerly city purchasing agent for Long Beach, Cal., has been appointed assistant city manager.

H. P. NAWN

Henry P. Nawn, president of the Hugh Nawn Contracting Company, Boston, Mass., died March 28th at Gilboa, N. Y., where his firm is constructing the new $6,000,000 "Gilboa Dam," for the City Board of Water Supply, New York City. Mr. Nawn, who was sixty-six years of age, has performed several prominent public works, among them being the subway at Cambridge, Mass., and the Boston Elevated Railway structure in Boston.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

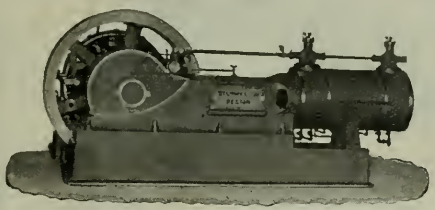
SUMMIT STREET SWEEPING MACHINES.

Following long observation, experiments, improvements and regular work in the streets of Akron, the new vacuum sweeping machines manufactured and sold by the Summit Street Sweeping Machine Co., have been perfected from the designs and patents of 1916 and are now under commercial production.

They eliminate dust by the vacuum system and do not require any sprinkling device. They clean the street from curb to curb with a large broom and a gutter broom, self adjusting to depressions and irregularities of the surface. All moving parts are positive or gear driven, and there are no annoying loose chains. The elevator will not clog and tear and the vacuum cannot become choked because the heavier refuse is handled by an elevator and the lighter part handled by the vacuum.

Considerable economy is due to the fact that the rear broom has been in constant operation on one of the machines for six weeks with very little sign of wear under service where other makes of brooms have to be changed every few days.

The machine has a capacity of 3 yards, is operated by a 60-h. p. motor, has Timken roller bearings throughout, double internal expanding service brakes on rear wheels, a rear broom 20 inches in diameter and 66 inches long, and an auxiliary or gutter broom 42 inches in diameter. Both brooms, the fan and the conveyer, are driven independently of the driving mechanism of the truck.



TYPICAL STUMPF UNA-FLOW STEAM ENGINE, HORIZONTAL TYPE.

UNA-FLOW ENGINE

This engine, manufactured by the Stumpf Una-Flow Engine Co., takes steam through the cylinder in one direction only, following the piston and exhausting through ports at the far end of the stroke in contrast with the ordinary counter flow engine where the steam enters at the end of the cylinder and follows the piston during the working stroke returning with the piston exhaust at the same cylinder end, and causing great loss of steam and much cylinder condensation.

The Una-Flow system avoids cylinder condensation and has a cylinder head jacketed with live steam.

The Una-Flow engines claim marked superiority over other types in freedom of cylinder scoring or lubrication trouble even when highly superheated in its use. Economy is promoted by the smallness of leakage losses which are a minimum from cylinder condensation, volume of clearance, throttling, friction, leakage of valves and pistons, heat radiation and condensation, and incomplete expansion. The superiority of these engines is most noticeable when using high pressure or slightly superheated steam, when condensing with good or moderate vacuum, and when running with variable loads with heavy overloads for short periods and long periods of light or idling loads.

MARTIN-PARRY GARBAGE DUMP BODY.

This new Martin-Parry Garbage Dump Body No. 291 for Ford Truck users is similar in construction to the standard Martin-Parry Dump Body. It has a capacity of 40 cubic feet with dimensions of 72 x 44 and height of 20 inches. The body weighs 640 pounds. The inside is perfectly smooth without a bolt or nut to obstruct materials, and entire body is made of 10-gauge steel.

The body is now equipped to take extra side boards, and the garbage dump body has end gate gasket to make the body absolutely water tight. The covers are hinged and lock in place to secure

60-H. P. SUMMIT STREET SWEEPER MACHINE WITH ELEVATOR AND VACUUM.

MARTIN-PARRY STEEL DUMP BODY.

the garbage and to prevent the escape of odor. The body is equipped with a hand operated hoist, which will raise it to an angle of 47 degrees, and the body can be dumped in twenty seconds.

The hoist is fool proof, back geared three-to-one and operates through a BB chain running over a cast steel sheave gear. The double acting tail gate can be swung from top or bottom.

This body can be secured for $222.25 from any of the Martin-Parry Plants, which are located in all the larger cities east of the Mississippi River.

CATERPILLARS FOR RAILROAD-TYPE SHOVELS

The Bucyrus Co. is prepared to equip all sizes of railroad-type shovels with caterpillar traction.

This announcement, because of the economies of operation thus made possible, should prove of particular interest to all present users of railroad-type shovels as well as to prospective purchasers.

The principal advantages of mounting a shovel of this type on caterpillars may be summarized as follows:

No time lost in moving up.

An ordinary move requires about 10 seconds only.

No rails to lay.

No jacks to release and set.

No stops during operation to reset jacks.

The shovel is always ready to dig.

The shovel does not have to face blasting.

May be moved back out of the way quickly and easily.

Can be turned around quickly.

No track trouble when in water.

In emergencies, such as slides, can be moved back quickly out of danger.

Shovel can always dig at most effective distance from bank; short moves easy and quick to make.

No delay on account of boulders rolling in close to shovel.

Lighter work for pitmen.

Saves from 2 to 4 pitmen and sometimes more.

Can travel and work on approximately same character of ground as shovel on railroad trucks.

Where shovel on railroad trucks requires blocking under jacks and both rails, when working on soft ground, the shovel on caterpillars requires blocking only under the caterpillars.

This mounting consists in general of two forward caterpillars, replacing the jack arm, and two rear caterpillars mounted under the rear end of the shovel.

The front caterpillars are both drivers and are so designed that they can swivel and adjust themselves to unevenness of the ground. The rear caterpillars consist of two units mounted on the same frame. They are designed with sufficient strength to permit the crossing of holes and ditches without the delay incidental to filling in.

Steering is accomplished through the rear caterpillars. The massive steering arm is integral with the pintle of the rear caterpillar trucks. It carries a heavy gear segment which engages a pinion on a vertical shaft. It is driven by an independent center valve, reverse type engine, suspended underneath the car frame. This engine may be operated either from the operator's stand or from ground alongside the rear caterpillars. Steering in curves of large diameter can be accomplished by the swinging of the boom without the steering mechanism.

Propelling is accomplished through the front caterpillars, both of which may be driven together or each one independently, forward or backward, at speed of about half a mile per hour. The shovel can climb with ease 15 to 20 per cent. grades.

For transportation by rail, railroad trucks may be easily substituted.

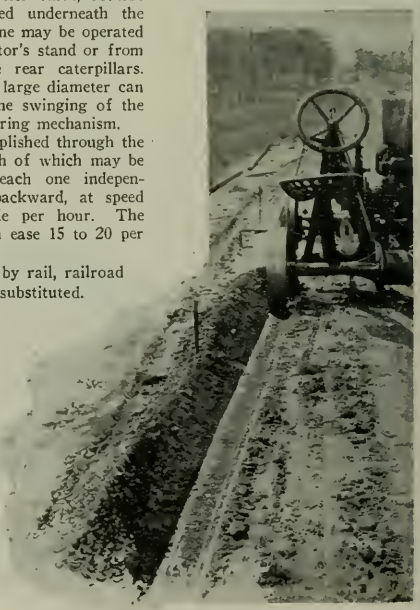
The Bucyrus Co. was the first manufacturer to equip dragline excavators and revolving shovels with caterpillars. Well over one hundred caterpillar-mounted Bucyrus machines, weighing from 65 to 220 tons, have been sold within the past eight years and are successfully operating.

BUCYRUS RAILROAD TYPE STEAM SHOVEL EQUIPPED WITH CATERPILLAR TRACTION.

THE CARR FORMGRADER

This appliance, manufactured by Edward G. Carr, is a locomotive machine, provided with a cutter drive held against the blade line by a hair spring and kept in exactly the proper position by a hand wheel turned by the operator so as always to insure the proper depth of cut. The cutter knives only 2-inches wide are progressively set to cut a trench 8 inches wide through the shoulder earth.

The formgrader works from its own power, cutting 300 to 700 feet per hour under ordinary conditions, has a reverse gear and traveling speed of 4,000 feet per hour for moving from job to job, and can easily be run on a truck under its own power without dismantling.



THE CARR FORMGRADER.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 April 29, 1922 No. 17

Gilboa Dam Construction*

Quarries, sand pits, washing and screening, concrete mixing and placing.

Stone for concrete and for ashlar masonry is derived from the excavation for the main dam and from the Riverside and Stevens Mountain quarries. Most of the cyclopean stone is excavated at the dam site and is handled by the main cableway there. The concrete stone, excavated at the same place, was at first handled by steam shovels, dump cars and steel derricks, which were afterwards superseded by the main cableway that receives the stones in large skips and dumps them into a loading hopper, delivering to 4-yard cars, which run down-grade on a wooden trestle 70 feet long and are carried above the spoil bank, where the waste is deposited, to a Number 5 gyratory Austin crusher installed at the Churchill plant. The crusher is served by a stiff-leg derrick with 45-foot boom. It is driven by a 60-horse power electric motor and is served with two 24-inch belt conveyors, 190-feet and 210-feet in length.

The cableway has two 150-foot wooden towers suporting the 1,900-foot cableway span that is equipped with a 2½-inch cable, 2,600 feet long, ¾-inch cable 2,800 feet long, 92 carrier blocks and 2,500 feet of ⅜-inch chain and one spreader bar with hooks, and one signal tower. It is operated by one 300-h.p. electric motor. In addition to the cableway, the dam is equipped with four steel guy derricks having 150-foot masts and booms, two traveling derricks with 37-foot masts and 75-foot booms, and one traveling derrick on the spillway with a 40-foot mast and a 75-foot boom. The derricks are operated by four Lambert 52-h.p. electric engines, and two Lidgerwood 2-drum engines. The foundation was kept dry by means of one 6-inch Warner steam duplex pump, one 6-inch and one

*Part 1, Exploration Borings, pressure tests, river diversion, foundation excavation, installation of plant was published March 25.

SAND SCREENING AND WASHING PLANT.

3-inch Worthington steam duplex pump, and one 6-inch centrifugal electrical pump.

STONE QUARRIES

The Riverside quarry produces a good quality of sandstone traversed by vertical and horizontal seams that enable it to be taken out in blocks 5 or 6 feet thick with very little blasting, the required sizes being obtained by drilling and plug-and-feather work. The quarry is equipped with one stiff-leg derrick and two grey derricks, operated both by steam and air, and there is installed there an air-driven planer to dress the faces of the edge stone. About 1,500 yards of stone were quarried during the season and most of it was delivered to the dam by trucks or teams which will be superseded by cars operated on a narrow-gage railroad that has been constructed from the quarry to the dam.

A large amount of stone is quarried on Stevens Mountain, where the soil was stripped from the ledge rock by an hydraulic monitor operated at 140 pounds nozzle pressure. The water was pumped by two 10-inch double-phase and one 10-inch single-phase Lee-Courtney electrical centrifugal machines at the rate of 1,900 gallons per minute delivered through a 10-inch spiral pipe line extending from the Manor Kill to the quarry site. From June 1 to August 1 about 4,000 yards of earth were removed by the monitor. A cyclone well drill with a capacity of drilling 40 feet of 6-inch holes in 8 hours has been installed at the quarry and the stone is loaded by a steam shovel into 4-yard side-dump cars operating on a narrow-gage track leading from the quarry to the crusher.

At the quarry there are intsalled one 42x48-inch jaw crusher and two gyratory crushers. A stone aerial tramway 3,670 feet long has ten intermediate towers 22 feet high, a 1¼-inch cable 4,100 feet long, 1⅛-inch cable 4,100 feet long, a ¾-inch cable 7,500 feet long and 32 buckets with a capacity of 1 1/9-cubic yards each. To operate the tramway and the quarry machinery there are installed ten electric motors of from 5 to 150 h.p.

SAND PITS

All of the sand used was from local deposits of glacial drift, most of it being finer than was considered most desirable, but otherwise of satisfactory quality. Small quantities of sand were derived from the Cherry Knoll pit and from the river flats along the creek below the Schoharie bridge. The main supply is situated near the intake about 2¾ miles from the dam, with which it is connected by a narrow-gage railroad. The sand in this pit varies from coarse gravel to fine sand with pockets of clay, and is excavted with a Thew steam shovel that loads into 4-yard dump cars hauled in trains of six to the sand-washing plant at the dam site. The sand cars are hauled over the 4,000 feet of narrow-gage railroad by an 18-ton dinky locomotive.

At the sand-washing plant the sand is dumped through a hopper to a grizzley that feeds a 24-inch belt conveyer 150 feet long that is driven by a 30-horse power electric motor. The conveyor carries the sand up an incline to a revolving screen with ¼-inch openings through which the sand is washed by a constant stream of water and is conveyed through wooden flumes to settling cones with automatic bottom valves through which the acceptable sand is drawn off, while the dirt and fine sand overflow with the water at the tops of the cones. The coarse material is rejected from the end of the revolving screen and the washed sand is delivered to buckets and transported to the concrete mixers by 1¼-yard buckets operated on the aerial tramway 560 feet long, at a speed of 500 feet per minute. The tramway has a 1¾-inch rope for the loaded buckets and 1¼-inch rope for the empty buckets, both of which are supported with a single intermediate tower. About 600 gallons of water per minute is required for washing the sand. The tramway is operated by a 30-h.p. electric motor.

MAIN STONE CRUSHER PLANT

The Stevens Mountain quarry crusher plant is equipped with a Traylor 42 x 48-inch Bull Dog jaw crusher set on a concrete base near the end of a 300-foot trestle which carries the railroad track from the quarry. From this crusher the stone passes to a No. 16 Traylor gyratory crushes that delivers to a 200-foot belt conveyor serving the screen and discharges into the storage bin. From the storage bin it is chuted to a boom belt conveyor 90 feet long that discharges to storage pile. Tailings are crushed in a No. 5 Traylor gyratory crusher, and delivered by a bucket conveyor to the screen. The screenings are delivered by a belt conveyor to a separate storage pile.

All of the equipment in this plant is electrically operated, and it has a capacity of 150 yards per hour. The storage pile is located over an 8x8-foot wooden tunnel 180 feet long, through which two 2-yard cars are hauled by a hoisting engine to the storage bins.

The storage bins deliver by gravity to 32 one-yard buckets spaced 250 feet apart on an aerial tramway 3,670 feet long that is operated at a speed of 500 feet per minute to deliver the stone to the concrete mixer. The tramway has 10 towers supporting the 1¾-inch cable for the full buckets and the 1⅛-inch cable for the empty buckets. The lower end of the tramway is located near the Churchill crusher and delivers the broken stone to the belt conveyer, depositing it in storage bins over the mixer.

The cement storage house, with a capacity of 18,000 bags, delivers to the 2,000-yard storage room under the concrete mixer by means of 18 buckets each of 6-bag capacity, spaced 400 feet apart on the 3,300-foot long aerial tramway that has a 1¼-inch cable for loaded buckets and ⅞-inch cable for empty buckets, and that travels at a speed of 500 feet per minute. The cables are supported on eight intermediate towers of an average height of 18 feet, and their drums are operated by a 40-h.p. electric motor.

CONCRETE PLANT

The main concrete mixing plant, located centrally, receives the cement, sand and broken stone from the tramways. It is equipped with a 56-cubic foot capacity Lakewood drum mixer driven by one 82-h.p. electric motor and supplied by gravity with sand and stone from overhead bins with capacities of 290 and 340 yards, respectively, the cement being delivered from below by an elevator. The concrete is discharged into two elevating buckets in the hoisting

tower, which deliver into a receiving hopper in the top of the tower, where it is spouted to position in the dam.

The double-shaft hoisting and boosting towers are respectively 168 and 150 feet in height and are connected by a 430-foot span cableway, from which are suspended 14-inch concrete chutes. The four hoisting buckets are of 2-yard capacity and are handled by two Lakewood double drum hoisting engines driven by electric motors. The chutes are inclined at a slope of 1 on 2¾. The concrete is proportioned 1:2.52:5.04 and is mixed with the minimum quantity of water necessary to provide for its flow through the chutes. It is made with Nazareth and Whitehall brands of cement and is mixed with water delivered through a 4-inch gravity pipe line laid by the contractor.

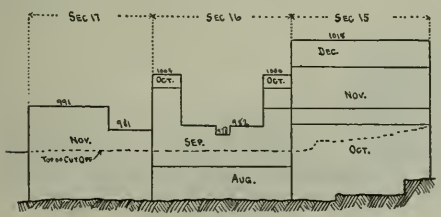
During the latter part of August peculiar behavior of the concrete was noted, in that the surface of the concrete exhibited a network of cracks two or three inches deep appearing two or three hours after the concrete was laid. Varying the proportions of sand, water and stone did not prevent the cracks, but they were finally avoided by keeping the surface of the concrete thoroughly sprinkled with water until after it had attained its final set.

CYCLOPEAN MASONRY

Concreting for the foundations of the main dam was commenced August 10, 1921. In section No. 16 it was laid in very irregular masses 75 feet long between contraction joints. The concrete was at first mixed in a ½-yard machine operated until August 16th, when the 2-yard machine in the main concrete plant was put in service and delivered through the steel chutes already mentioned. Water control was completely effected on August 25, when the concreting in the cutoff trench was commenced and as fast as successive areas of the foundations were prepared, the concrete was built up in them in sections separated by vertical contraction joints and maintaining an offset longitudinal elevation as indicated in the accompanying sketch.

The rock strata were very irregular and lying at various angles intersected by seams and fissures in different directions, making a dovetailed mass of angular fragments with considerable water entering through the seams. This leakage was collected in sumps, drained by a 4-inch longitudinal pipe laid in the bottom of the cutoff trench.

The contraction joints are generally 76 feet apart extending in vertical planes across the full width of the dam and sealed by a flexible 7 x 1-16-inch vertical copper strip 15 feet from the dam line that has



MONTHLY PROGRESS OF CYCLOPEAN MASONRY ON GILBOA DAM, 1921.

both edges firmly imbedded in the concrete of the adjacent section. Originally the contraction joints were made against steel forms, but these were afterwards replaced by plain wooden forms, and rough wooden forms are used for other portions of the concrete surfaces. The section of the dam that contained the two 9-foot by-pass pipes was only 35 feet between joints.

The cyclopean stones are handled by the main cableways and the face stones are usually set in advance of the concrete so as to act as forms. The blocks are bedded in 1:2½ mortar joints with the joints raked out to a minimum depth of 2 inches. The tread stones are grouted with 1:1 mortar before work is begun on the rises. The edge stones are anchored back to the cyclopean masonry by 1½-inch round rods not more than 5 feet apart, with eyes engaging anchor pins.

GROUTING

The foundation of the cutoff trench was grouted through a line of 2-inch diamond drill holes, in the tops of which pipes were set and extended as the masonry was brought up. The bottom for section 18 was badly seamed with vertical cracks and 32 grout pipes were set, subjected to 75-pound air pressure and charged with grout made with 23 gallons of water to one bag of cement, and afterwards finished with a thicker grout made with 12½ gallons of water per bag of cement. In all 213 cubic feet of grout were used for these holes.

New Jersey $40,000,000 State Highway Bill

New Jersey State Highway Bill introduced January 10, 1922, referred to the Committee on Judiciary and eventually passed by the Legislature, has been vetoed by the Governor, but passed over his veto and will be submitted for general vote at the next fall elections.

The bill provides for the issue of bonds not to exceed $40,000,000 for the purpose of paying the cost of construction, improving, reconstructing and rebuilding the main highway system as now authorized by law, or portions thereof, including bridges. The bill carries provision for a state tax of not less than one mill on the dollar of the assessed value of real and personal property during the years 1923-1927, inclusive. It is estimated that $30,000,000 will be required for road building bonds of a maximum life of 20 years and that $10,000,000 of bonds with a maximum life of 15 years will be required for bridges.

The plan is expected to provide for issuing not more than $8,000,000 worth of bonds per year for the next five years and to furnish a sinking fund for retiring the bonds and a surplus, which it is estimated in 1927 will be more than $3,000,000, applicable for the reimbursement on commitments that the State Highway Department has made with counties and municipalities and which in future would not be made.

By this arrangement the State system would be completed in five years and first class roads would be provided at an early date, instead of being delayed from 12 to 15 years under the present high-

way system. The repairs and upkeep of the old roads and bridges under the present highway system cost about $4,000 per mile for 500 miles; when reconstructed according to the plans the upkeep cost will be less than $500 per mile annually, showing a saving of more than $1,750,000 yearly, which will be available for distribution to the counties for aid in the maintenance of county roads.

Rapid Construction of Concrete Road

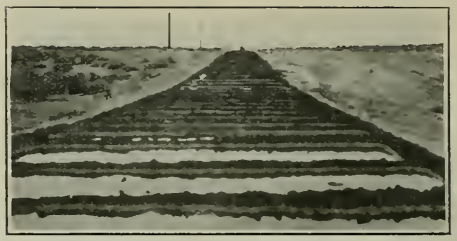
Seven and a half miles of eighteen to twenty-foot road laid in a desert country in fifty-four days.

Road district improvement No. 12, 7.6 miles long from Lokern to McKittrick, Kern county, California, was paved last fall by Rogers Bros. Co. of Los Angeles, for a contract price of $348,700, the work being completed in 54 calendar days, commencing September 1st and finishing the concreting November 24th, after which the shoulders were finished and the work accepted December 12th.

The pavement was 7 inches thick and varied in width from 18 feet to 20 feet, increased sometimes on curves to 24 feet.

The location was in a dry, sandy, hilly, desert country with grades from 2 to 6 per cent and curves up to 6 degrees. The 1:2:4 concrete was reinforced over fills. The grading was done with Fresno scrapers. The aggregate was delivered by rail, and unloaded by clam shell buckets at two storage yards at the opposite ends of the route, from which the average haul was 2¾ miles for one paver and 2 miles for the other paver. Multifoot 21A mixers were used.

AGGREGATE DISTRIBUTED AHEAD OF PAVER



PONDAGE CURBING ON A GRADE

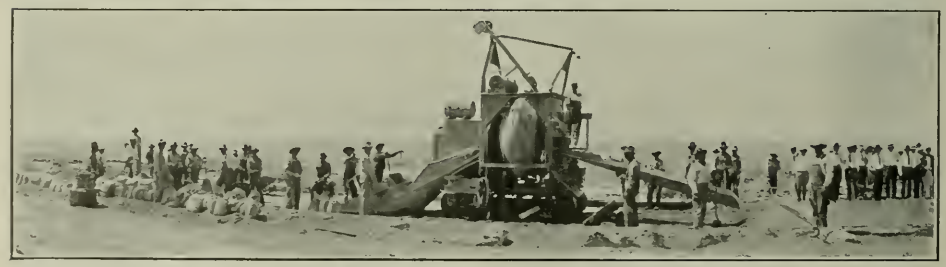
Two camps were established, one for each paver and built respectively 4 1/2 miles of road from the Lokern camp and 3 miles from the McKittrick camp.

Crew No. 1 constructed pavement 18 feet wide on the tangent and from 3 to 5 feet wider on curves. The best day's run, on November 11th, was 695 linear feet, equal to 270.7 cubic yards. The best five consecutive days' run averaged 643.4 linear feet or 250.21 cubic yards per day. The best 20 consecutive days' run averaged 546.65 linear feet or 230.11 cubic yards and included three days when no work was done, one day when the waterline broke and one day when the cement supply failed.

The No. 2 mixer crew laid 9,000 linear feet of pavement 18 feet wide and 7,600 feet of pavement 20 feet wide, almost all of the latter being laid on 6 to 6½ per cent grade with curves superelevated from 2 to 3 feet and located in the mountains where no detour roads were provided. The best day's run was 692 linear fet, equal to 269.11 cubic yards of 18 x 7-inch roadway, on November 1st. The best five consecutive days' run averaged 631 linear feet or 245.39 cubic yards. The best record for 20 consecutive days averaged 559.2 linear feet or 227.60 cubic yards, with four no-work days.

Water was delivered through a 7-mile line of 3-inch pipe and the pavement was cured by the pondage system. Work was done under the direction of Paul E. Pressley, consulting engineer, and Jay Jellick, resident engineer. C. C. Rogers was superintendent in charge of crew No. 1 and Hugh L. Rogers superintendent in charge of crew No. 2.

The contractor reports that during 1921 the two pavers used on this job laid respectively 20,000 and 25,000 cubic yards of concrete at a cost of not more than $152 for repair parts, exclusive of cables and minor adjustments made on the job by the crews, and no delays were caused to the work.



SERVING PAVER FROM ADJACENT STOCK PILES BY WHEELBARROW GANG.

Jefferson County's Road System

By E. M. Wheeler

Chert, gravel and "red ash" used for secondary roads, generally built by county forces. Special attention is paid to maintenance, which is performed by convicts which are kept in seven camps, twenty to sixty in a camp.

It has been the policy of the road officials of Jefferson county, Alabama, not only to build roads, but to maintain them; and not to spend money for roads, but to invest money in roads. As a result of the practical application of this policy, the road system of this county is the pride of the state and one of the best in the country.

In Jefferson county a system of main paved roads connecting the principal centers of the county and providing for the heavy traffic, are fully supplemented by a veritable network of well-constructed and maintained secondary roads, reaching into most of the smaller towns of the county and tying the main roads together at convenient intervals. Finally, the more generally used earth roads are maintained in good shape by dragging.

The activities of the department are carried on under two heads, though both are under the direction of the Board of Revenue. The engineering activities, including surveys and the supervision of contract work, are handled by C. J. Rogers, county highway engineer. The construction of the secondary roads, maintenance of them, and the care of the county prisoners is under the management of the writer as superintendent.

Jefferson county is the richest and one of the largest counties in Alabama. The county seat is Birmingham, industrial metropolis of the south, and a city of 260,000 population. At present large road construction program is being begun with the proceeds of a recent sale of $2,000,000 of road bonds, about 40 miles of paved roads being under construction, while there have been completed 61 miles of bituminous pavement laid on a concrete base, 136 miles of bituminous top road on stone base, and 253 miles of graded and charted roads. The area of the county is about 1,100 square miles, and the total mileage of roads about 1,400. In addition to the 400 miles of road already improved, many miles of earth roads are maintained in first class condition

CONSTRUCTION

Warrenite, sheet asphalt, and bituminous concrete have been tried out satisfactorily. Where a concrete base has been laid, a thickness of 5 to 7 inches has been considered necessary, no reinforcing being used. The concrete mix has been 1:3:5 and 1:3:6. Integral curbs are constructed in connection with the concrete bases. A 2-inch crown is usually used. The thickness of the asphaltic wearing surface varies from 2 to 3 inches, depending upon the material and the type of base.

These roads have been built by contract. Their cost has varied with the changing conditions of construction during the past few years. The roads constructed with concrete base formerly cost about $40,000 per mile, but are now being built for about $30,000 to $35,000. The paved roads with stone base average about $20,000 per mile. All these roads have been built on a permanent basis of width and grade. A standard of 18 feet has been adopted for the width, and where possible all grades are limited to 5 per cent.

The same regulations as to grade and width apply, wherever possible, to the secondary roads. Many of these are not strictly secondary roads, but main roads that have not been paved. Chert, gravel and red ash are the surfacing materials. Gravel is used least of all; chert and ash interchangeably, according to which is handiest for the particular job.

The gravel is secured mainly from branches or small streams. Chert is secured from pits or banks. It is a flint-like rock that has decomposed or separated, so that it is found in about the same variety of sizes as bank gravel. It compacts well into a road, and wears well. It occasionally must be loosened with powder in the pit, but usually is easy to handle and spread. Pits are usually rented from the owner of the property at a rate of 5 cents to 8 cents per load of chert removed.

Ash costs nothing. It is the product of combustion in the waste piles of the coal mines of the county. The slate, muck, and other wastes of mining are stored in huge heaps near the mines as the easiest means of disposal. These heaps eventually catch fire, the result of the burning being a red ash which weighs about 1,600 pounds to the cubic yard, and which posseses sufficient cementing power to

A ROAD CONSTRUCTED BY PRISONERS IN JEFFERSON COUNTY.

*Road Superintendent of Jefferson County, Ala.

make a fine road material. In fact, it has some advantages that chert does not have, wearing smoother and evener, not washing so badly, and not raveling. So far as is known, this is the only place where this red ash is used for road work, though it must be available in all soft coal regions.

These secondary roads are sometimes built by contract, but usually by county forces. When the latter method is followed, the grading, especially if this is heavy, is done by contract. Plans for the future call for a grading gang, but practically none of this work is done at present.

In constructing these roads, the bed is shaped and crowned by machine, and 6 to 8 inches of red ash or chert applied to the surface. The ash or chert is hauled by motor trucks from the nearest pit or mine mouth, and dumped on the road. A scraper is used for spreading this material, and this is accomplished without leaving any hard-packed spots to turn into bumps later on. Rolling is generally not believed to be necessary and this department has found that roads compact very well under traffic, if scraped and reshaped once or twice during the packing process.

For an average road, about 2,000 cubic yards of chert or ash is required per mile. The cost of such a road, exclusive of grading, averages from about $1,000 per mile for the most favorable conditions of construction and haul, to $3,000 under the most unfavorable conditions.

The life of these roads varies from one to three years, depending mostly upon the amount and weight of traffic. They will not, of course, stand up for long under heavy trucks, especially during the wet season. Under average traffic conditions, the life exceeds two years, and a reshaping and scraping is necessary every two to three months or thereabouts, to keep them in first class condition.

MAINTENANCE

Road construction, after all, is a comparatively simple matter, and, in many ways, not so important as maintenance. It has been on maintenance that this branch of the county road forces has concentrated its greatest efforts, realizing that no matter what the original cost of the road, maintenance is necessary, and that without maintenance, the money spent on roads is almost a total loss. The object has been to keep every main road and every well-used secondary road in good condition for traffic, irrespective of weather or seasonal conditions.

The organization necessary for such a task, is, of course, a large one, and the work of keeping in shape nearly a thousand miles of road is costly. Added to this is the new construction work, which is carried on by the same forces.

CELL AT CAMP NO. 4

The personnel for doing this work consists of about 250 convicts, with enough foremen, guards, and skilled labor to make an efficient and smooth running organization. The free labor is employed in the operation of motor trucks, and in similar work requiring skill, intelligence and responsibility. These men are concentrated in seven camps located at strategic points throughout the county. To each camp is assigned responsibility for the condition of the roads in its district. The area assigned to these camps varies with the amount of road, its condition, and the number of men assigned to the camp, but generally varies from 150 to 250 square miles.

The personnel at the camps also varies, ranging from 20 to 100 men. The strictly road camps range from 20 men for the smallest to about 60 men for the largest. No. 2 camp is located at the county farm. Here are kept the prisoners unfit for the heavy work on the roads. They are employed, where capable of any work at all, on laundry, gardening and similar light work. It is the plan of the department to raise enough material on the county farm to materially reduce the living costs at the various camps. At No. 2 camp is also located the garage and shop for the repair of the county road equipment.

No. 1 camp is one of the smaller camps located about ten miles out of the city. About 25 men are maintained at this camp and the road working equipment includes 2 motor trucks, 20 mules, 10 wagons and 3 road machines. This camp is responsible for road construction and maintenance over an area of about 150 square miles.

No. 2 camp, as already stated, is at the county farm. In addition to the work already mentioned, the camp does considerable road work. The equipment includes 7 trucks, 2 combined tractors and road machines, and other smaller equipment. About 100 prisoners are kept at the farm and the camp.

No. 3 camp is located at Trussville. It is the only white camp operated by the department. About 60 men are kept at this camp, making it the largest of the strictly road camps. Three motor trucks, 20 mules, 10 wagons and 1 combined tractor and road machine are in use by this camp.

No. 4 camp carries from 30 to 40 colored prisoners and the equipment includes 6 motor trucks, 14 mules, 7 wagons, and 4 combined tractors and road machines. This camp maintains about 260 square miles, with about 300 miles of roads.

No. 5 camp is at Rosedale, southwest of and just outside the city limits. About 40 men are worked. The equipment includes 6 motor trucks, 20 mules, 10 wagons and 3 mule-drawn road machines.

No. 6 camp is located in the northern end of the county. There are 33 men, 20 mules, 10 wagons, 1 truck, and 3 road machines, one tractor drawn.

No. 7 camp is just being located in the south end of the county, at McCalla. It will have about 20 men, 1 motor truck, 16 mules, 8 wagons, a combined tractor and road machine and one mule-drawn road machine.

These camps are under the direct supervision of the road superintendent, who has charge of the construction and maintenance of all roads, excepting those constructed under contract.

(To be continued)

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Plans for Water Works and Sewers

Last week we published the fourth of a series of articles dealing with the requirements of the several states that apply to the preparation by engineers of plans for water supply and sewerage. The first two gave abstracts of the state laws requiring that engineers be licensed in the state in question before practicing in it. The third and fourth stated, for each state, the conditions under which such plans must be submitted to the state health boards.

These will be followed, beginning next week, with brief synopses of the regulations of the several state boards specifying the kinds of maps, plans and reports that must be submitted. There has been some delay in the appearance of these articles because replies from some of the states have been coming in slowly, but we hope to complete the two or three instalments in which these data are to be presented in seccessive issues following the next one.

In examining the conditions under which plans must be submitted, we find that in some states there are no requirements whatever. These include Colorado, Delaware, Florida, Indiana, Michigan, Rhode Island, and South Dakota; although in some of these it was expected that such a law would be passed soon. In others, the state board, through personal influence and persuasion, have got the cities to ask its approval of such plans before they are constructed.

Alabama and Virginia, while requiring the approval of plans for water supply, have no such requirements concerning sewerage plans.

There are eight states from whose health boards or health officials we have not received replies to our inquiries, and we are of the opinion that in most if not all of these there are no requirements of this nature. If any of our readers can furnish us with information concerning the laws as to such requirements in these omitted states we will greatly appreciate receiving such information.

Most of the state laws authorize the state health boards to make and enforce regulations governing the preparing and submitting of plans and reports, and these regulations will form the subject matter of the articles that are to follow.

Imhoff Tank Discussions

Another series of articles that are of interest, and we believe of value, to all engineers engaged in sewerage work, is that in which discussions of the Imhoff tank are presented. These began with four instalments in January and February of an article by Russell Riker describing experiences with thirty-seven Imhoff tanks in New Jersey. In succeeding issues appeared discussions of this article by Waldo S. Coulter, J. G. Skeels, George T. Hammond, Paul Hansen, M. B. Tark, and Geo. L. Robinson; and in the April 22nd issue was a description of a patent taken out by Dr. Imhoff covering a process of mixing fresh sewage or sludge with Imhoff or other sludge.

This week we are presenting a discussion of the subject that contains some ideas obtained by a close observer during several years of operating such tanks; and we have others in hand and promised. Altogether, we consider Mr. Riker's article and these discussions as forming a most valuable contribution to the subject.

None of the writers seem to claim that the Imhoff tank has no faults, but several ask, or imply: "Is there any tank, however, which has less?" There is apparent agreement that the results with the Imhoff tank are somewhat better than with the septic tank when both are on their good behavior, but that the former can give an operator more kinds of trouble than the latter and with less apparent or discovered cause. At least one operator who has had charge of both kinds for years has told us that if he could he would abandon the Imhoff and go back to the septic.

One interesting and significant development is the patent recently issued to Dr. Imhoff wherein he provides for improving the operation of the tanks, including the Imhoff tank, by mixing fresh sewage or fresh sludge with the partly digested sludge. This naturally suggests the English hydrolytic or Travis tank which preceded the Imhoff tank in point of time but seems to have received little attention in England and practically none in this country.

The difficulty with the Imhoff tank most often referred to is the foaming, but Mr. Downes in this issue names a number of other less spectacular and glaringly evident, but which are important factors in successful operation of the tank.

As to foaming, there are all sorts of opinions as to both the cause and the remedy. Some have had

apparent success with one treatment, some with another, and both have proved failures in other plants. Some, having tried all the remedies of which they have learned and without any mitigations of the trouble, have reached the pessimistic conclusion that the only thing to do when a tank begins to foam is to let it foam until it is ready to stop, meantime doing as much as possible by hand labor to keep the foam from polluting the effluent.

It is admissible to think that there is no law governing the operation of an Imhoff tank, although the law may vary with variations in the tank design and especially in the character of the sewage. We certainly should not admit that it is beyond the skill of chemists, biologists and engineers to discover the cause. And we believe that it will be discovered; unless in the meantime a more satisfactory substitute is brought forward.

Principles of Contractural Relations

A joint committee was formed some time ago by the combination of committees appointed by the Boston Society of Civil Engineers and the New England Water Works Association, to report upon the eight important principles of contractural relations prepared as a part of the national movement inaugurated by Secretary Hoover. This joint committee has submitted its report, which is given below, somewhat abbreviated.

At the conference called by Secretary Hoover, attended by representatives of nine national engineering and contracting societies, some progress was made toward a standardization of construction contracts, with the aim of ultimately securing

"1. Less expenditure for legal services in drawing proper contracts, and the elimination of disputes over contracts already drawn.

2. Less duplication of work in the professions attendant on construction.

3. Better safeguard for owners and increased public confidence, and

4. An improved standard of construction service throughout the country."

The eight principles were published by the Associated General Contractors as follows:

1. The award of contracts on a basis of skill, integrity and responsibility, with the policy where practicable of eliminating irresponsible or inappropriate bidders before their proposals are received.

2. A satisfactory arbitration clause to be legally binding upon both parties.

3. A definite policy of inspection, with provision that if two or more separate interests are concerned in payment one authority shall act for all.

4. Specification of either the results to be obtained or the method to be followed, but not both.

5. Acceptance of work within a definite period after fulfilment of the contract, and as short a period of maintenance as is practicable.

6. Removal of responsibility from the contractor for contingencies beyond his control.

7. Reasonable limit upon the amount to which work under the contract can be increased or decreased.

8. Definite time and method of payment with provision for materials delivered.

"A study of the eight principles above outlined can only be made on a basis of broad interpretation. In public work, political conditions, existing statutes and other factors make it impracticable to follow out some of these principles.

"Therefore, in interpreting the principles which are endorsed by this committee in the following paragraphs, it should be borne in mind that the intention is that they are to be considered only on a broad basis, for adoption where conditions permit; that they cannot be taken literally in all cases; and that every construction contract cannot be written to include all of the principles. Furthermore, there are other principles of equal importance which should be incorporated in the same way, and which should be given due weight in writing a contract for construction work. The time available to this committee for its work has not permitted a consideration of these other important factors, except indirectly as they may have had a bearing on the principles hereinafter stated.

"With the general qualifications hereinbefore given, this committee endorses the following principles of contractual relations:

1. That proposals be invited only from responsible bidders; and that contracts be awarded with due regard to skill, integrity and experience.

2. (The conditions appertaining to different classes of work vary to such an extent that the committee does not feel prepared to endorse the principle of arbitration for universal application, although recognizing its desirability in many cases.)

3. That if two or more separate interests are concerned, one authority shall act for all,

4. That as a matter of general principle, either the results to be obtained or the methods to be followed shall be specified, but not both where they would conflict.

5. That work be accepted within a definite period after the fulfilment of the contract; and that as short a period of maintenance be required, as is practicable.

6. That the contractor be relieved of certain responsibilities for specified contingencies beyond his control,

7. That where the character of the work will permit there should be a stated limit upon the amount to which work under the contract can be increased or decreased, due to a change in plan,

8. That there be a definite time for, and method of, payment; and that where practicable and advantageous there be provision for payment for certain specified materials delivered, for the safekeeping of which the contractor shall be responsible."

"We believe that it is possible to prepare a standard form of contract, including only such general clauses as would be applicable to all construction contracts, or perhaps to certain classes of construction contracts, so that the general procedure covered by such clauses will be standardized, to the great benefit of all parties concerned in construction work."

A 12-mile section of highway near Champaign, Ill., will be tested by the State University to determine efficiency and cost of oils and methods of application and time that oiled road is in good condition.

North Avenue Viaduct, Milwaukee*

Shoring, forms and arch centers used by the contractor, together with equipment.

SHORING AND FORMS

The arch ribs were supported on 3x10-inch lagging surfaced on all four sides. Lagging, 6x1-inch was used for the construction of most of the forms, for which there was required in all about 1,500,000 feet board measure of lumber. The shoring consisted principally of 2x4, 2x6 and 2x8-inch boards with 6x6-inch posts and some 2x12 and 3x10-inch planks. The shoring on which the viaduct forms were supported was completely detailed in the contractor's office and was erected like steel bridge falsework, in accordance with a plan and diagram. It was taken down and re-erected over and over again and eventually cut up for forms and other purposes after having served all the requirements for the shoring. The forms were made in comparatively large panels, all of them built in the shop to exact detailed drawings, thus reducing the field work and minimizing mistakes and delays.

All of the large forms were braced by interior horizontal wire ties that were very quickly and efficiently tightened by special outside steel angle clips, which were set and locked with a single motion and requiring no tools besides a hammer and a small bar. The clips were made of a 4-inch length of standard 2x2-inch angle with a center hole and two end slots in one flange. The other flange was set horizontal, with the vertical flange in contact with the outside of the form and the projecting ends of two wire ties were bent 90 degrees and inserted in the slots. The angles were then quickly revolved about 140 degrees until the edges of both flanges took bearing against the vertical side of the form and the wires, which were securely jammed in the slots, were thoroughly stretched and locked in position. This device, which was invented by L. J. Klug, was found more expeditious and satisfactory than any other method of fastening and tightening the wires and has been made the subject of a patent application.

ARCH CENTERS

Each of the arch ribs was supported during construction on three steel arch trusses, designed and fabricated by the contractor. The three trusses for each rib were braced together in pairs, each connected by horizontal and diagonal members. The trussed members were made entirely of pairs and double pairs of angles up to 6x6 inches, riveted together, back to back, with gusset plate connections. For each truss the top chord was shop riveted in sections with part of the web members attached. The remainder of the members and the bottom chords were shipped in separate pieces and all were assembled and the field splices bolted at the site and the trusses erected as units on falsework provided for the purpose. The total weight of all the trusses with their bracing was about 130 tons.

The arch trusses were not supported at their extremities, but had bearing on the flanges of the lower chord angles 7 feet on centers from the arch soffit at spring line. These bearings were seated 5 feet, 4 inches apart on a sill transverse to the bridge axis and composed of three 12-inch I-beams bolted together with separators. Under each truss the sill was supported with two sets of three wooden wedges in each set, making a total of six sets providing adjustment and elevating the sill a maximum of 15 inches above a lower sill consisting of five 12-inch I-beams riveted together with separators, under each of the two upper sills. Jackscrews set on the top flanges of the lower sill were placed in pairs on both sides of the trusses, four pairs in all for each end of each span, and served to raise and lower the trusses, adjusting them to the required elevation after which the wedges were driven to follow up and take the load. The wedges were made from 6x12-inch and 12x12-inch oak timber, tapered 2 inches in 3 feet. After the arch ribs had been poured and had set 30 days the jackscrews were replaced between the sills, the wedges driven out, the three trusses lowered onto rollers and moved over into position for the other arch ribs.

For each span the lower sills rested on eight lines of riveted steel stringers supported at the piers on the caps of a double bent of timber falsework, having altogether sixteen 12x12-inch vertical posts braced together with transverse and diagonal struts and seated on the extended concrete footings of the piers and abutments, to which the vertical posts were braced by horizontal struts bolted to the vertical concrete webs.

CONTRACTOR'S EQUIPMENT

Besides the items already mentioned, the principal plant installed by the contractor included another stiff-leg derrick with 75-foot boom, located at the east end of the bridge, one Mundy and one Lambert two-drum hoisting engine, one 220-foot Insley steel hoisting tower, one single drum Lidgerwood hoisting engine, one 150 horsepower Scotch marine boiler installed at the mixer plant and supplying steam for the adjacent hoisting engines, one C. H. & E. hoisting engine in the yard, one Browning revolving steam shovel mounted on caterpillar traction and equipped with a ½-yard clamshell bucket and auxiliary 40-foot boom, and one electrically driven combination punch and shears used for fabricating the steel arch trusses.

There was a carpenter shop supplied with a circular saw, two combination saws, one 36-inch band saw, and a 24-inch jointer, all driven by electricity. There was also an oxy-acetylene torch used almost constantly for all sorts of cutting and repair work, including the brazing of the cylinder heads.

The maximum force employed was about 300 men, and the average about 100 men. No labor troubles were experienced. The viaduct was opened to street car and pedestrian traffic December 4, 1921, and to vehicle traffic December 15, 1921, the short delay being due to the paving of the roadway which was done under a separate contract.

The bridge was designed and built under the direction of the department of public works of the city

*Continued from page 280.

of Milwaukee, Percy Braman, Commissioner of Public Works and David McKeith and M. C. Cutler, Superintendents of Bridges and Buildings. The contractor was the Klug & Smith Co., Milwaukee. W. O. Krahn and George R. Young were respectively superintendent and field engineer.

Imhoff Tank Results

By John R. Downes*

The claims made for the Imhoff tank and the extent to which they are justified by results obtained are discussed by one of the leading sewage plant operators of the country.

One of the most experienced, thorough and successful operators of sewage treatment plants in the country is the superintendent of the plant serving Plainfield, North Plainfield and Dunellen, New Jersey. His discussion of the subject introduced by Mr. Riker's articles in PUBLIC WORKS, which he has kindly written at our request, is a most valuable contribution to the literature of the subject.

In commenting on the articles by Mr. Riker and others which have recently appeared in PUBLIC WORKS, my first duty is to say that Mr. Riker has done a real service in setting forth the present status of the Imhoff tank; if, indeed, the present conditions can be said to constitute a status.

Mr. Paul Hansen's attitude is typical of that of nearly every consulting engineer with whom I have come in contact: i. e., "if we condemn the Imhoff tank, what have we to take its place?"

In order to decide whether or not one can succeed "in making a case against the Imhoff tank," we should compare the claims made for the tank with the results obtained by its operation. The question is, do we consistently get a better effluent from Imhoff tanks than from other available types of sedimentation tanks; and, if we do, is the result obtained at a reasonable cost for construction and operation?

My personal experience of four years with septic tanks and five years with Imhoff tanks on the same sewage would indicate that we do not get value for our money.

The following is an outline of the claims made for the Imhoff tank:

(1) That the solids would be separated from the liquid by sedimentation exactly as they are in septic tanks or "plain settling tanks."

(2) That the solids, once settled out, would be deterred by the sloping baffles and gas traps from again contaminating the flowing sewage—that the result would be a consistency better effluent than could be obtained from septic tanks.

(3) That the removal of the settled solids from the settling tank to the digestion tank could be accomplished at less expense than the removal of solids from a plain settling tank to a disconnected tank for further treatment.

(4) That the removal of solids from the digestion tank could be accomplished at little cost and without nuisance.

(5) That the operation of the Imhoff tank would be free from the objectionable odors more or less generally associated with septic tanks.

(6) Continuity of service, making possible the use of fewer units, would lead to economy of construction. As would, also, the construction of the settling tank within the digestion tank.

Results obtained:

(1) On claim one, the tanks make good. The Imhoff tank clarifies the sewage by sedimentation the same as any other settling tank which has been designed with due regard for resulting velocity of flow.

(2) Has not been established in practice in the majority of Imhoff tank installations. The effluent of the settling tank is all too frequently fouled and made more or less septic and odoriferous by the presence of partly digested solids returned from the digestion tank by way of one of four sources. These sources I classify, arbitrarily, as follows: (A) gray foam, (B) black foam, (C) film, (D) brown gelatinous flock.

(A) Gray foam is the typical yellow-gray froth, usually acid in reaction, and of a nauseating, sour odor.

(B) Black foam pours over the tops of the gas vents as does the gray foam but much less violently, it is alkaline and has usually only a musty odor.

(C) Film is a black inky liquid that almost always exists at some point in the digestion tank between the scum and the sludge. When it reaches the vicinity of the slots, it is bound to pass through into the settling tank by diffusion and by way of thermal currents. I call this inky liquid "film" because of the rapidity with which it forms a film upon the surface of the settling tank. It is highly charged with hydrogen sulphide, the odor of which it imparts to the tank effluent and it causes an unwarranted oxygen drain on subsequent oxidizing devices. This "film" must be recognized as getting into the settling tank in the form of any inky liquid, as distinguished from masses of black solids which sometimes rise in patches and at once suggest dirty slopes or slots.

(D) The brown, gelatinous flock, I take to be the same thing as the black "film," except that it has not reached the same stage of digestion. It has something the appearance of an iron hydroxide flock, but is much lighter. Like the black, inky liquid it is a vagrant, drifting somewhere between the sludge and the scum of the digestion tank.

Evidently Imhoff predicated his combination of the settling and digesting tanks with slot connection on the theory that there would be a clear line of demarcation between sludge and supernatent liquid. Operating experience shows that we do not get such clear division and the persistent presence of the two conditions outlined above (as also of a viscous yellow liquid which seems to precede their production) suggest that some other than a slot connection between settling tank and digestion tank is necessary.

So much attention has been focused on the "foaming" of tanks, that one is apt to get the idea

*Superintendent Plainfield Joint Sewage Disposal Plant.

that a tank which is not foaming is working satisfactorily. Foaming is an intermittent difficulty, the above conditions are persistent sources of trouble.

(3) Claim three, the inexpensive transfer of settled solids from the settling tank to the digestion tank of the Imhoff combination, is an established fact. Later developments of cone bottom tanks and air displacement sludge ejectors seem to open the way to a connection more satisfactory than a slot between the settling and digesting tanks.

(4) Claim four, the removal of solids from the bottom of the digestion tank of the Imhoff combination, is certainly accomplished at little cost. Odor from the sludge is less than that from septic tank sludge because we are able to draw ripe sludge without the inclusion of that which is still decomposing. The odor caused by the exposure of well-ripened sludge on drying beds must be recognized, but is one of the minor sources of trouble.

(5) Personal experience would indicate that as between Imhoff tanks and septic tanks treating the same sewage there is little choice as to odor. Considering only the quality of the effluent and cost of operation, I think that Mr. Riker's suggestion for a multiplicity of septic tanks to be operated in rotation would be preferable to Imhoff tanks. We must face the fact, however, that in time we will have to collect and control the gases evolved in the digestion process. Collection of gases could be better provided for in a comparatively deep digestion tank with correspondingly small surface area. The same consideration would lead to the adoption of the chimney type of gas vent in preference to the longitudinal vent on the digestion tank wherever one felt justified in installing the Imhoff combination. The work of gas control, recently reported by C. E. Leonard, city engineer of Austin, Texas, is a great advance in the art of sewage disposal. (Engineering News-Record, April 6, 1922.)

(6) Claim 6, continuity of service, is not achieved by the Imhoff combination. It is constantly necessary to cut out tanks, the effluents of which have become fouled by the conditions described under claim (2). If a plant is liberally designed, we might possibly depend upon keeping two-thirds of it in condition for operation. The building of the settling tank within the digestion tank seems a good deal like trying to make two things occupy the same space at the same time. It seems that the expense of building an entirely separate settling tank would be justified by the number of difficulties which it would eliminate. This is specially true as a number of engineers have even overdesigned the settling tanks in order to provide space for the digestion tank beneath it, where deep construction of the digesting tank was to be avoided.

Throughout this discussion I have used the terms settling "tank" and digesting "tank" in preference to the term "compartment" because I wish to emphasize the fact that they are two separate things combined simply for the purpose of transferring solids from one to the other.

Dr. Travis aimed at separate digestion of the solids after removal from the liquid, but was handicapped by the belief that an admixture of fresh sewage was necessary to sclid digestion. Imhoff thought this belief a fallacy and made the separation more complete, but retained the easy method of transferring the solids from tank to tank. Both overlooked presence of the vagrant film-producing liquid which torms in the vicinity of the slots; hence a step forward that is in order is the recognition of the presence of this trouble maker. It seems logical to prevent this return action by shutting the gate instead of leaving the slot open.

Having in this way assured ourselves of a fresh, well clarified effluent, which is our aim, if there is any difficulty in digesting the sludge, that is another problem to which we should apply ourselves at once. I believe that investigation will prove this oft-mentioned difficulty to be a mere bugaboo.

Automobile Camps in Florida

At least thirty-eight established auto camps in the state, of which a survey was made by the State Board of Health, and sanitary control of them was urged.

Probably few if any of the eastern states are visited by a larger number of camping automobilists than is Florida, and it certainly is to be questioned whether any of the states pay more attention to the sites used by the auto tourists for camping purposes. In a paper recently read by George W. Simons, Jr., the chief sanitary engineer of Florida, he stated that a conservative estimate of the number of auto tourists in Florida last winter was 10,000, a considerable percentage of which spent more or less of their time in tourist camps. At the end of 1921 there were at least 38 established auto camps in that state, 30 of which were maintained by the municipalities and the remainder by private individuals. All of these were located conveniently along heavily traveled highways in so-called tourist centers.

Realizing the importance of the sanitary conditions surrounding these camps to the health not only of the tourists themselves but also of the residents of the country in which they were spending several days or weeks, the state board of health urged all communities that were visited by tourists to use the greatest diligence and attention in maintaining sanitary conditions at the camps. A survey was made of the camps in the state, particular consideration being given to what Mr. Simons considered the six fundamental requirements, namely: (1) Is the camp established in accordance with the provision of a city ordinance and is such ordinance being fully observed by camps? (2) Who superintends the camp and how efficiently is it supervised? (3) What is the source of the camp's water supply and where is it located? (4) What disposition is made of human wastes—by city sewerage, septic tanks, or privies? (5) What disposition is made of rubbish, garbage, etc., and what is the frequency of removal? (6) Are refuse containers provided and what number?

It was found that 15 of the 38 camps were regulated by local ordinances conforming to the regula-

tions of the state board of health. Three of these ordinances had been adopted prior to 1921 and the remainder during the latter half of that year. Last October West Palm Beach established and equipped a camp in charge of a paid superintendent and adopted ordinances which were so complete and admirable that copies were sent by the state board of health to the other cities of the state to be used as a model.

Seven of the municipal camps are in charge of paid superintendents or special officials designated to care for such places. Seventeen camps are supervised solely by marshals or town police. Mr. Simons believed that camps having more than 20 campers continuously should be in charge of a special designated official, while those having few campers may not warrant a full-time inspector. The private camps operated for profit are generally in charge of paid superintendents who maintain good sanitary conditions.

A prime essential of every camp should be a plentiful supply of pure drinking water. Most of the cities where camps are located have recognized this and where possible have piped city water to the camps, or have driven wells where city water was not accessible.

Of the 38 camps, 21 are provided with flush toilets connected with the city sewers or to septic tanks of approved design.

The trash and refuse should be collected from camps, at least once a day where the camp is large, although fewer collections may be required for the smaller camps. There should be at every camp a number of metal, tightly covered garbage cans. The medium size camps usually provide from 6 to 10 cans, or one for every 5 to 7 automobilists, and no camp should provide less than 2.

Highway Work Done During 1921

Tabulation of data for several hundred counties in the various states, giving total amount spent—county, State and Federal funds—and the amount of each kind of construction for which this money was used.

County and State	Money spent for highway work	Kinds and amounts of highway construction
Alabama		
Etowah	$69,529	5 mi. chert surf. & 2 mi. Tarvia surf. treatment
Montgomery	300,000	Gravel & conc. bridge work
Arkansas		
Crittenden	2,850,000	14 mi. conc. surf., 53 mi. gravel surf.
Hempstead	313,000	29 mi. gravel
Scott	20,000	Graded road work
California		
Fresno	1,250,000	60 mi. asph. conc.
Plumas	60,000	Maintenance only
Sacramento	400,000	6 mi. conc. at $15,000 per mi.—$110,000 for bridge
Solano	125,000	9,000 lin. ft. asph. conc. ($35,000)
Sutter	644,752	11.7 mi. rein. conc.; 23.2 mi. oil mac.
Yuba	205,000	10.2 mi. block base, warrenite top
Colorado		
Chaffee	.....	4 mi. gravel roadbed, bridges, etc.
Elbert	120,000	30 mi. dirt. surf., bridges & culverts
Lake	14,362	½ mi. loam rd. graveled
Lincoln	80,000	Sand & gravel surf. & natural dirt grade
Logan	269,797	3,900 lin. ft. conc.
Delaware		
New Castle	850,000	2 mi. W.B. mac. surf. treated., 3 mi. blt. mac., 4.2 mi. surf. w. blt. mac. conc., 5.2 mi. surf. w. conc. 2 mi.
Idaho		
Clark	6,500	Gravel surf.
Power	116,500	14.2 mi. gravel surf.
Shoshone	117,533	5½ mi. graded natural gravel surf.
Illinois		
Calhoun	140,000	Earth construction
Carroll	131,000	1 mi. gravel, 1 mi. mac., 10 mi. oiled earth
Christian	230,000	Oiled earth & earth
Clay	25,600	Earth grading, 10 or 12 mi. conc. slab.
De Witt	.....	Oil surf.
Fulton	210,000	Earth work & bridges
Hamilton	36,000	Earth work
Iroquois	220,000	6 mi. gravel, 9 mi. conc.
Johnson	50,000	Earth
Kane	730,000	13 mi. conc. (18 ft. P. C.)
Knox	300,000	Conc. roads
Lee	250,000	3 mi. stone rd., 12 mi. gravel
Logan	80,000	15 mi. gravel
Marion	.....	Earth
McDonough	185,000	Earth rds., 70 mi. grading work; maint.
McHenry	221,000	1 mi. conc., 5 mi. grad. for conc. rd.
Monroe	60,000	4 mi. mac.
Pope	33,125	8 mi. gravel rd.
Pratt	20,000	Grading earth & deep fills
Pulaski	200,000	18 mi. earth rd. bed, 20 mi. gravel, 5 mi. mixed
Stephenson	250,000	Grad. & bridge work for hard surf. rd., $130,000
White	100,400	$56,000 gravel
Williamson	276,000	6 mi. conc., 7 mi. gravel
Winnebago	304,224	9.25 mi. conc.
Woodford	.....	Graded earth 56,320 ft.
Indiana		
Decatur	250,000	10 mi. mac., 5 mi. conc.
Dubois	100,000	10 mi. plain mac.
Hancock	300,000	13 mi. conc., 6 mi. stone, 30 mi. gravel
Henry	85,000	For bridges
Howard	175,000	3 mi. conc., 5 mi. stone, 7 mi. gravel
Jackson	50,000-75,000	¼ mi. rein. conc., 4 mi. screened gravel
Jasper	500,000	20 mi. gravel, 50 mi. crushed stone
Jennings	73,000	4 mi. gravel, 6 mi. mac.
Johnson	469,000	10 mi. 1-course conc., $284,000; 15.49 mi. grav., $175,000
Madison	656,000	180,000 sq. yds. cem. conc., 8½ mi. grav.-crushed stone
Morgan	265,000	25 mi. gravel, 10 mi. stone, gravel & crushed stone
Posey	.....	Gravel only
Shelby	328,557	½ mi. conc., 12 mi. stone & 25¾ mi. gravel
St. Joseph	1,198,406	21.35 mi. conc., 6.14 mi. asph. penetration, 11.2 mi. gravel
Vermillion	140,000	2½ mi. conc., 3 mi. gravel, 3 conc.
Vigo	2,500,000	14 mi. conc., 5 mi. asph., 5 mi. brick, 35 mi. gravel
Wayne	280,000	50,000 sq. yds. conc. pavt.
Iowa		
Adair	185,000	Earth
Allamahee	122,694	$60,000 earth rd. to permanent grade
Benton	690,000	9 mi. 18-ft. conc.
Blue Hawk	112,000	2 mi. grav. surf., & some grad. & drain.
Boone	390,000	25 mi. gravel
Bremer	130,000	$100,000 earth
Buena Vista	90,000	10 mi. gravel
Cass	180,000	Bridges incl. in this amt.
Cerro Gordo	710,000	13 mi. conc. 18 ft. wide, 8 mi. gravel
Chickasaw	124,000	$89,000 bridge, 16 mi. gravel surf.

Highway Work Done During 1921—Continued

County and State	Money spent for highway work	Kinds and amounts of highway construction
Iowa (Continued)		
Clarke	190,000	$35,000 earth rd.
Clay	67,740	53 mi. gravel surf.
Clinton	1,160,000	17.2 mi. conc.
Crawford	75,000	Earth
Dallas	380,000	85 mi. gravel surf.
Davis	287,000	Dirt
Decatur	20,000	Earth
Dickinson	250,000	52,800 sq. yd. conc.
Dubuque	200,000	None
Floyd	321,702	5.6 mi. conc., 8.88 mi. graveled, 6.67 mi. graded
Guthrie	330,000	12½ mi. earth
Hamil	200,000	5 mi. gravel surf.
Hancock	350,000	10 mi. conc., 4 mi. grad. & gravel. surf.
Harrison	55,000	$15,000 earth rd. to perm. grade
Jackson	150,000	16 mi. earth const., 150 maintained
Jasper	180,000	14½ mi. gravel rd., $54,400
Kossuth	400,000	Earth surf., $300,000
Linn	250,000	6½ mi. conc., 40 mi. earth
Lyon	225,000	$110,000 perm. grade, $40,000 gravel surf.
Marshall	420,000	5.93 mi. 18' rein. conc., 4¾ mi. gravel
Mitchell	250,000	27 mi. drain., grad. & gravel
Monona	173,822	All for bridges & grad.
Monroe	90,000	Earth
Montgomery	125,000	Dirt roads
Muscatine	320,137	All grad. work, culverts & bridges
Palo Alto	580,000	9 mi. conc., 30 mi. grav. surf.
Pocahontas	538,935	43 mi. gravel surf.
Pottawattamie	123,636	$60,000 earth
Ringgold	100,000	Earth rds. to perm. grade
Sac	315,000	43 mi. gravel
Scott	1,392,862	15 mi. brick, 3 mi. mac.
Shelby	135,234	None
Stony	400,000	25 mi. gravel
Union	316,000	15.5 mi. perm. grade & bridges
Wapello	175,325	Dirt $39,182.67
Warren	235,300	No Surf.
Webster	400,000	24 mi. gravel
Worth	90,000	9 mi. graded, now being graveled
Kansas		
Anderson	400,000	7½ mi. gravel.; excav. & culverts on 8½ mi.
Barton	264,865	3 mi. conc., 150 mi. temp. grade
Bourbon	400,000	21 mi. bitum. mac.
Butler	250,000	None
Clay	27,800	Dirt rds. only
Closed	132,000	No. surf.
Doniphan	268,056	5 mi. conc. rd.
Finney	985,000	20 mi. conc. 16-ft. slab
Geary	292,075	7.8 mi. conc. (2-course), 1 m. (1-course), .716 mi. brick
Greeley	7,000	16 mi. earth
Harvey	90,863	Sanding 5 mi., $6,050
Jackson	68,060	92.75 mi. graded
Kearny	13,169	None
Mitchell	420,422	10 mi. conc., 70 mi. earth grading
Montgomery	550,000	24 mi. gravel rd.
Neosho	97,278	50 mi. dirt, 1½ gravel
Pawnee	38,477	3 mi. sand-clay, $8,575.50
Republic	174,000	None
Sheridan	40,000	Dirt rds. only
Sumner	419,395	Conc., $209,144; earth, $80,238.
Wabaunsee	93,180	$30,662 dirt work
Wichita	6,000	Earth
Kentucky		
Allen	284,000	.7 mi. rock asph., 14 mi. grav. surf., 6 mi. grad.
Boyle	62,000	W. B. mac.
Daviess	150,000	6 mi. grav.; grad. earth rds.
Hancock	100,000	13 mi. grad. & drain
Henderson	202,310	15 mi. grad. & drain, 5 mi. gravel, 2½ grav. resurf.
Morgan	20,000	Grade work only
Owen	52,000	3 mi. W. B. mac., 3 mi. new location, heavy grad.
Rockcastle	187,000	3 mi. mac., 5 mi. grad., 4 mi. surf. treat., bridge
Shelby	136,000	Bitum. surf.
Trigg	340,000	Gravel
Whitley	160,000	W. B. mac. surf. treated
Louisiana		
Allen	160,000	22 mi. gravel rds.
Caldwell & La Salle	150,000	Sand-clay gravel 14 mi. in Caldwell & 16 under const.; 14 in La Salle
Maryland		
Kent	220,000	6 mi. 15 ft. wide conc.
Massachusetts		
Middlesex	.....	3,500 mi. public rd, all sorts surf.
Michigan		
Alger	274,258	W. B. mac. $50,000, grad. & drain. $110,000
Branch	350,000	Gravel 9 ft. wide, 8 ft. depth
Eaton	354,380	1.335 mi. conc. base & bit. top, 42.205 mi. grav. surf.
Huron	485,976	6 mi. conc., 2 mi. Tarvia pen., 41 mi. gravel
Kalkaska	100,000	½ mi. conc., 6 mi. gravel
Luce	120,000	7 mi. W. B. mac.
Macomb	1,000,000	23.25 mi. gravel, 7.75 mi. slag-gravel, 9.83 mi. cem. con., 5.25 mi. asph. conc.
Mecosta	175,000	1 mi. conc., 10 mi. 16-ft. gravel, 12 mi. 9-ft. gravel
Oakland	1,866,743	15½ mi. conc., 34½ garvel, 15 asph., 1 brick
Ontonagon	175,000	6 mi. mac., 7 gravel, 19 sand clay
Minnesota		
Aitkin	270,000	27.33 mi. gravel
Blue Earth	300,000	60 mi. gravel, $140,000
Chippewa	194,119	25 mi. gravel surf.
Clay	184,062	15 mi. gravel, 15 earth
Cottonwood	114,000	14 mi. dirt, 4 gravel
Crow Wing	388,433	4.4 mi. conc., 20 clay-gravel surf.
Dakota	460,961	1 bit. hard surf., $54,222; 33.2 mi. graded & graveled rds., $321,945
Dodge	196,219	20½ mi. graded rd., 13 mi. graveled
Faribault	363,057	71 mi. gravel surf.
Goodhue	168,500	25 mi. gravel surf.
Grant	99,992	5 mi. earth, 15 gravel
Hubbard	265,000	41 mi. graded
Isanti	110,286	15 mi. gravel surf.
Jackson	160,000	77 mi. gravel surf.
Kandiyohi	500,000	14 mi. conc., 15 grad., 15 gravel
Lake	140,000	58.25 mi. gravel & earth rds.
Lincoln	70,993	6 mi. gravel
Lyon	269,582	40.2 mi. grad., 24 grav. surf.
Martin	261,470	7 mi. dirt, 22 mi. grav. surf.
Meeker	364,000	All gravel surf.
Murray	126,000	24 mi. gravel
Nobles	184,239	$63,712 gravel
Norman	86,000	None
Ottertail	300,000	30 mi. gravel, 15 mi. earth
Pope	60,000	8 mi. grad., 15 gravel
Redwood	137,000	$58,000 gravel
Rice	588,595	2 mi. conc., 53.73 gravel surf., 28.89 grade
Roseau	36,000	Gravel
Stearns	300,000	25 mi. gravel
Swift	152,090	7.4 mi. conc., 12 mi. gravel, 1 grad. & gravel
Todd	347,000	38 mi. gravel
Washington	144,000	10½ mi. grad. & gravel
Watonwan	316,000	$240,000 conc., $12,000 grav., $52,000 grad.
Mississippi		
Noxubee	77,000	$75,000 gravel, $2,000 sand-clay
Missouri		
Butler	150,000	16 mi. grad., bridge & culvt., 2¾ gravel surg., ½ conc.
Clinton	80,000	Dirt only graded to 6%
Cooper	100,000	Conc., brick, asph. & tarvia
Harrison	150,000	Dirt grade
Jasper	570,000	16¾ mi. conc., 18 gravel
Linn	118,000	Dirt rd. & bridges
Mississippi	550,000	$500,000 conc. rds. & bridges, $50,000 garded earth
Montgomery	40,000	Gravel, crushed rk. & earth
Rolls	22,000	10 mi. gravel, 20 mi. earth
Stoddard	170,000	Gravel surf.
Washington	50,000	10 mi. gravel
Montana		
Custer	125,118	13.8 mil. grad. & gravel, 119 mi. graded dirt, steel & concrete culverts
Deer Lodge	51,649	None
Granite	43,227	8 mi. gravel, 3 earth, maint.
Nebraska		
Knox	75,000	10 mi. gravel, 25 earth
Musselshell	88,907	None
Prairie	39,302	44 mi. graded earth rd.
Richland	35,398	$21.566 new work, dirt rds. & bridges; $80.76 machinery & supervision
Sheridan	50,000	21 mi. earth
Toole	125,000	12 mi. grad. & gravel, 70 mil. grad only
Valley	30,000	None
Nebraska		
Morrill	30,000	None
New York		
Salem	500,000	15 mi. conc., 10 mi. gravel
Sussex	442,000	1½ mi. conc., 16 mi. gravel
Union	575,000	.....

(*To be continued*)

NEWS OF THE SOCIETIES

CALENDAR

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 9-11—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. Atlantic City, N. J.

May 12 — NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19 — NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18 — CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE. Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines. Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 7 — NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16 — CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

AMERICAN WATER WORKS ASSOCIATION

Forty-second annual convention, Philadelphia, May 15-19, 1922.

Many papers have been put on the program especially for the benefit of the operating members. Look over the tentative program, a copy of which is mailed herewith, and select such papers as interest you or that are on subjects that you have had experience in and are thus qualified to discuss; prepare your discussion on all such papers and tell freely your own practice and experience for the benefit of fellow members. Especial attention is called to the Friday forenoon program, joint meeting with the chemists and bacteriologists to discuss water purification and chemical troubles.

Superintendents' program — Group meetings will be held on Monday, registration and committee meeting day, for the consideration of:

1. Office Methods, Records, Accounts, etc.

2. Pumping Station, Engines, Boilers, Firing, etc.

3. Filter Operation and Care.

4. Pipe Laying, Methods, Records, etc.

5. Services and Meters. Material of Services, Laying. Meter Setting, Reading and Care.

6. Water Sheds and Reservoirs, Their Care and Protection, Algae Treatment, Tree Planting.

7. Private Fire Protection Services. Especially inter-connection with polluted sources and the efficiency of double check valves on such services.

Papers scheduled for Superintendents' Day that are expected to be of interest to operating water works men, also, time is given for topical discussions, and the following subjects and questions have been suggested. Others are asked for.

Select the topic you are most interested in at the time, help form a group to talk it over, free from the restraints of the larger meetings. The Group Meetings are also intended to give the members a better chance to get acquainted.

If you are specially interested or have anything to tell on any of the Group Topics that will be a help to your fellow members please send word to the Secretary so that you can be assigned to the Group. Leaders of the discussions are needed for each Group and you are asked to volunteer.

(1) Methods of preventing tampering with water meters, use of devices, odd sized couplings for inlet and outlet, or others to prevent reversing a meter.

(2) Meter testing tanks, use of weight or volume in tests.

(3) Use of check valve on metered services and responsibility for blowing up of hot water boilers by reason of the installation of check valves. Legal decisions on this point are particularly wanted.

(4) Connections to high pressure fire systems for sprinkler or other private fire protection use.

(5) Underground electric conduits, their location in relation to water mains. Water from leaks carried by underground electric conduits.

(6) Experience with underwriters' double check valve on services to factories having a secondary fire supply from a polluted source.

(7) Removing lead joints from cast iron pipe, process and after use of removed lead.

(8) What proportion of scrap lead, ends of lead service pipe, old service pipes, lead from burned out joints, etc., can be used without injuring the lead for pipe joints.

(9) Extra strength joints, where especial care is needed, as under railroads. Use of tin or other alloys with the lead to strengthen the joint.

(10) Foundry prepared joints, economy in their use, are they as satisfactory and efficient as poured joints.

(11) Use of substitutes for lead in pipe joints.

(12) Use of modern cast iron service pipes of small size, for domestic services.

(13) Care of water sheds, fishing and boating permits on reservoirs and control of their use.

(14) Use of valves of less diameter than the mains.

(15) Fire hydrants, locating and spacing.

(16) Waste prevention for small plants. House to house inspection. Simple tests for main loss. Prohibitively high rates for wasteful plumbing appliances.

(17) Outfits for thawing fire hydrants, services and small water mains.

(18) Valves on main lines closing by reason of vibration, water hammer or other causes except breaking.

(19) Service pipes, who pays for them, and maintains after installation?

(20) Cleaning or sterilizing water pipes before laying or after laid and before put in service.

(21) Pollution from railroads running near or crossing supply streams or reservoirs.

(22) Oil saving devices for pumping stations, filtering, reusing, etc.

ENGINEERING TRAINING CONFERENCE

The Second Public Conference on Business Training of the Engineer and Engineering Training for Students of Business has been called by the U. S. Commission of Education on behalf of the Committee on Commercial Engineering, and is to be held at the Carnegie Institute of Technology in Pittsburgh, May 1st and 2d. Invitations to appoint delegates to this conference will be sent to engineering and scientific organizations, educational, commercial and trade associations.

VERMONT SOCIETY OF ENGINEERS

At the tenth annual meeting of the Vermont Society of Engineers, held in Burlington, March 10th, addresses were given by Judge S. R. Moulton on "The Development of Law in Relation to Engineering Problems" and by Allen Hazen on "Public Water Supply." The following officers were elected: President, James M. Morrison; vice-president, L. E. Dix; secretary, G. A. Reed, and treasurer, T. W. Dix.

New Appliances

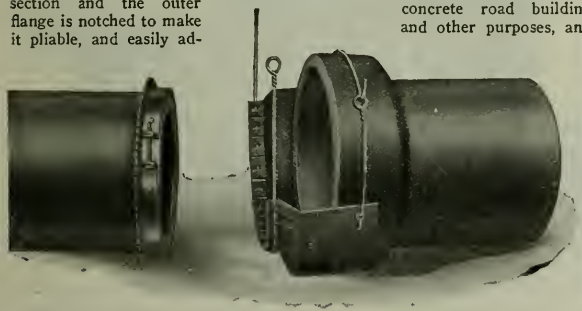
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

WESTON PIPE GASKETS AND FORMS

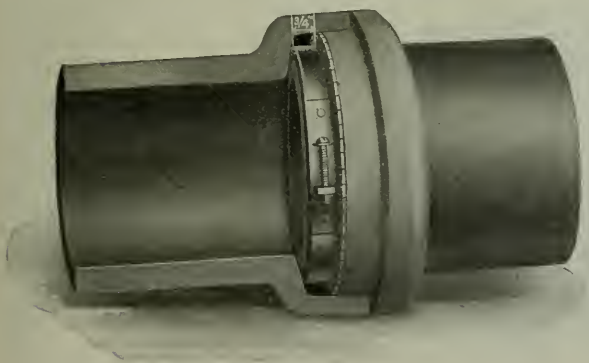
A flexible steel gasket and form that is quickly and easily applied to the hub and spigot joint of a tile drain or sewer pipe is manufactured and sold by L. A. Weston. The use of this gasket eliminates all other packing and insures the production of a tight joint and perfect alignment by common labor. With this gasket and form the proper pouring of cement can be quickly determined by inspection and the joints can be made in trenches containing water and with water running through the pipes, provided the depth of the water is not more than half the inside diameter of the pipe, thus sometimes avoiding an excessive amount of pumping or sub-drainage. The use of this device also permits partial backfilling of the trench before the joints are made, thus promoting proper alignment of the pipe and preventing the breakage of the joints during backfill. It also precludes the penetration of roots into the sewer.

The flexible form has an L-shape cross section and the outer flange is notched to make it pliable, and easily adjusted to the pipe. The gasket centers the pipe and takes up only ¾ inch in the depth of the socket, leaving the remainder of the space for the cement point. The gasket forms a full circle and is held in position by an adjustment bolt passing through radial flanges.

The form, which somewhat resembles the gasket reversed, also has a radial flange notched to give it flexibility. It is semi-cylindrical and is set on the lower side of the pipe and held in position by circumferential wires twisted tight. It is filled solid with thin cement mortar or grout and after this is set the top of the joint is trowelled.



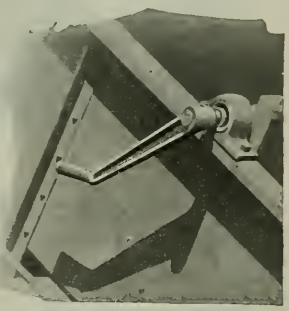
WESTON'S FORM FOR TILE PIPE CEMENT JOINTS.



CEMENT JOINT MADE WITH WESTON'S FORM AND GASKET.

HEIL SWINGING TRUCK PARTITIONS

The Heil Co.'s swinging partitions to subdivide truck dump bodies, separate their loads and permitting portions of them to be dumped independently and successively are extensively used for handling aggregate in batches for concrete road building and other purposes, and are claimed to be the most simple type on the market.

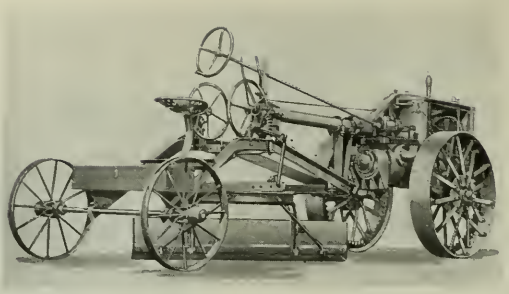


HEIL PARTITION CRANK.

HEIL PARTITION FOR DUMP TRUCK BODY.

Any number of partitions can be installed on any dump body, requiring only to bolt the bearings to the top of the body with a couple of small bolts at each bearing which can be quickly removed, leaving the regular standard body. The bearings contain an eccentric mounted on the axis of the partition. They have a crank easily operated by one man to raise the gate vertically until dowel pins at the bottom are disengaged from holes in the bottom of the body and gate automatically swings open, allowing the compartment to be emptied.

The Heil Co. manufacture dump and standard bodies, extended platforms, asphalt bodies, garbage bodies, hydro hoists and improved tailgates.



RUSSELL MOTOR HI-WAY PATROL.

MOTOR HI-WAY PATROL

This one-man motor propelled road maintenance machine, manufactured and sold by the Russell Grader Mfg. Co., weighs 2,475 pounds, does the work of 3 teams, has a 6-foot blade and a power unit rated at from 6 to 12 h.p.

It is simple, strong and rigid in construction, having the differential and transmission housings and engine bolted direct to the central master casting which carries the drive wheel axle. It has a 6-foot well curved blade, 13½ inches wide, with detachable cutting edge. The blade is raised and lowered by worm gear, giving very speedy, accurate adjustment and automatically locking the blade in position. The normal motor speed is 1,000 rpm. developing a rated brake horse power of 12 and a rated draw bar horse power of 6. The road speed is from 1½ to 3 miles per hour, wheelbase 144 inches, tread of tractor wheels 4 feet 10 inches, tread of grader wheels 5 feet 2 inches, length 184 inches, height 6 feet, turning radius 36 feet.

ELECTRIC LOCOMOTIVE TRACTOR

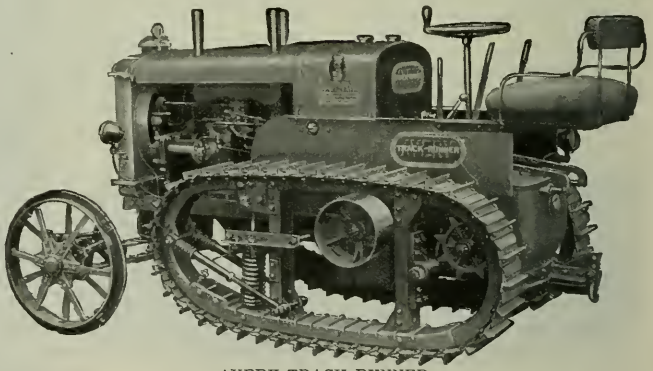
The standard 4-wheel tractor built by the Baker R. & L. Co., for heavy duty service on 24 to 36-inch gage tracks, has unusual weight and strength especially adapted for operation on rails where the weight is essential to drawbar pull. It can be equipped with an Ironclad battery of 24 cells or an Edison battery of 42 cells or their equivalent in other types and weighs 3,100 pounds without battery. It is operated by a Baker series wound totally enclosed 48-volt, 60-ampere motor, rating 1,550 r.p.m., 300 per cent. overload capacity in 60 minutes. It is of the 4-wheel drive type with a drawbar pull for continuous operation of 400 pounds and of 1,000 pounds for the starting, and with a speed of 6 m.p.h. without loads and 4 1/2 m.p.h. with loads.

BAKER R. & L. CO. ELECTRIC LOCOMOTIVE TRACTOR.

AVERY TRACK RUNNER

The Track Runner built by the Avery Co. for heavy traction on difficult surfaces is 48 inches wide, 9 feet long and 58 inches high, weighs 5,000 pounds, can turn in its own length and has speeds of 2 miles, 2⅔ miles, 3½ miles per hour, at 1,000 r.p.m. of its 4-cylinder vertical motor. All of the bearings are anti-friction roller balls. The length of the track assembled is 6 feet and the width of the pad is 8¼ inches. The track has automatic lubrication and the machine is steered by the front wehels assisted by clutches. It is equipped with a 30-gallon main fuel tank and can be operated with gasoline, kerosene, distillate or alcohol.

The accompanying illustration is reproduced from page 236, issue of April 1st, where it was mistakenly used in connection with a description of the new Avery 12-20 tractor, which is built with traction wheels and without track runners.



AVERY TRACK RUNNER.

VULCAN INCINERATOR COMPANY.

The Vulcan Incinerator Co. has recently incorporated with G. P. Strelinger, president; Gilbert Mueller, vice-president and chief engineer, to sell and construct the Vulcan Incinerator under the patents of the late William McCanse, who installed very successfully odorless and smokeless plants at Durant, Ardmore and Okmulgee, Okla.

This incinerator has been built with units having domed furnace chambers about 7 feet in diameter, made of steel, concrete and fire brick, capable of withstanding 3,000 degrees of Fahrenheit and operated with initial fires of coal, oil or gas, requiring, with the forced draught system, a very small amount of fuel for the initial fires and capable of evaporating and incinerating all refuse, garbage, night soil, street sweepings, carcasses, etc., to a complete ash, free from odors.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 May 6, 1922 No. 18

Constructing Prairie du Sac Highway Bridge

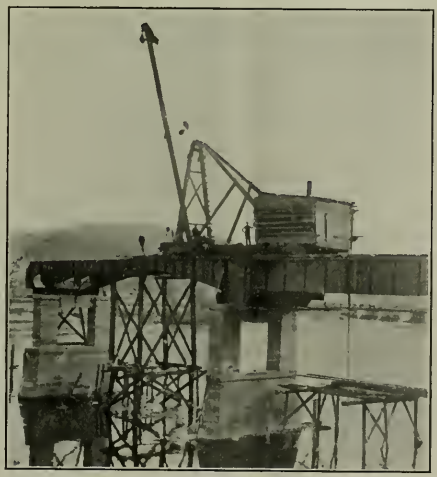
Cofferdam construction of piers and erection of steel by derrick-car and traveler for 18 plate girder spans. Concrete plant for substructure traveled on long trestle falsework.

The highway bridge across the Wisconsin river at Prairie du Sac, Wisc., was built for the Wisconsin Highway Commission by the Kelly Atkinson Construction Co., of Chicago, for a contract price of $175,000. It is 1,427 feet 6 inches long from out to out of steel work and about 1,440 feet long overall. It is on a 2 per cent. grade and the concrete piers and abutments have pile foundations built in cofferdams excavated below the river bottom. The superstructure consists of 17 regular 79-foot plate girder spans and one plate girder 77 foot Scherzer bascule span with a clearance of about 26 feet above high water. The main girders are spaced 21 feet apart on centers. The footings are protected with a rip rap, and the floor of the bascule span is paved with wooden blocks. The fixed spans have reinforced concrete pavement.

SHEET PILE COFFERDAMS.

At low water the depth of the river in the channel is 7 feet and the velocity 4 miles per hour. In high water the depth is 22 feet and the velocity 6 miles. The piers were constructed in cofferdams made of Wakefield sheet piles built up of 2x12-inch planks driven to a maximum depth of 14½ feet below low water level and a penetration of from 6 to 15 feet. The sheet piles were driven by a 2,100-pound drop hammer aided by an hydraulic jet and were pulled by a two-part wire rope tackle aided by the same jet.

The cofferdams were unwatered and the river bottom was excavated to the bottoms of the footings by one Nye steam-driven sand pump with a 4-inch intake that carried about 20 per cent. of the sand with a rise of 20 feet for the suction and 10 feet for the discharge; one Domestic gasoline pump with a 4-inch diaphragm that carried 50 per cent. sand and gravel with a 15-foot suction, and one Cameron test pump with a 3-inch intake, a 12-foot suction and 8-foot discharge that handled only clear water. The pumps were shifted from pier to pier, about 80 feet, by hand, requiring 6 men one hour for the Nye pumps, and four men 10 minutes for the Domestic pumps.



ERECTING BASCULE SPAN WITH TRAVELING DERRICK AND CENTER FALSEWORK TOWER.

FALSEWORK.

For the construction of the substructure the contractor built two service tracks parallel and adjacent to the axis of the bridge. These were carried on falsework with three-pile bents 21 feet apart, spaced to clear the piers. Each bent had one pile 2 feet 6 inches, one pile 12 feet 6 inches, and one pile 20 feet 6 inches from the center line of the bridge. The piles were capped with 12x12-inch transverse timbers carrying 9 lines of 12-inch 33½-pound I-beams borrowed from the permanent floor system of

the bridge superstructure. These I-beams were assembled together in sets of three, side by side, two sets carrying the 10-foot gage traveler track, 7½ feet on centers from the axis of the bridge, and the other group carrying the narrow gage service track on which concrete for the piers and steel for the superstructures were delivered from the shore to the traveler. During construction two cofferdams and 250 feet of the falsework trestle were washed away by a flood.

SAND PLANT.

Sand and gravel up to ¼-inch diameter were excavated by hand from a side-hill pit and delivered in wheelbarrows over a service trestle to an inclined double gravity screen discharging into a 15-yard storage bin with two compartments for gravel and one for sand. The hopper bottoms of the bins discharged into dump buckets on 36-inch gage flat cars hauled 3,000 feet in trains of five by a Milwaukee gasoline locomotive to the end of the bridge and thence to the position of the traveler on the service track, where the four yards of stone and gravel and one yard of sand were delivered to the 6-yard elevated storage hopper. The aggregate train made a 6,000-foot round trip in about 15 minutes.

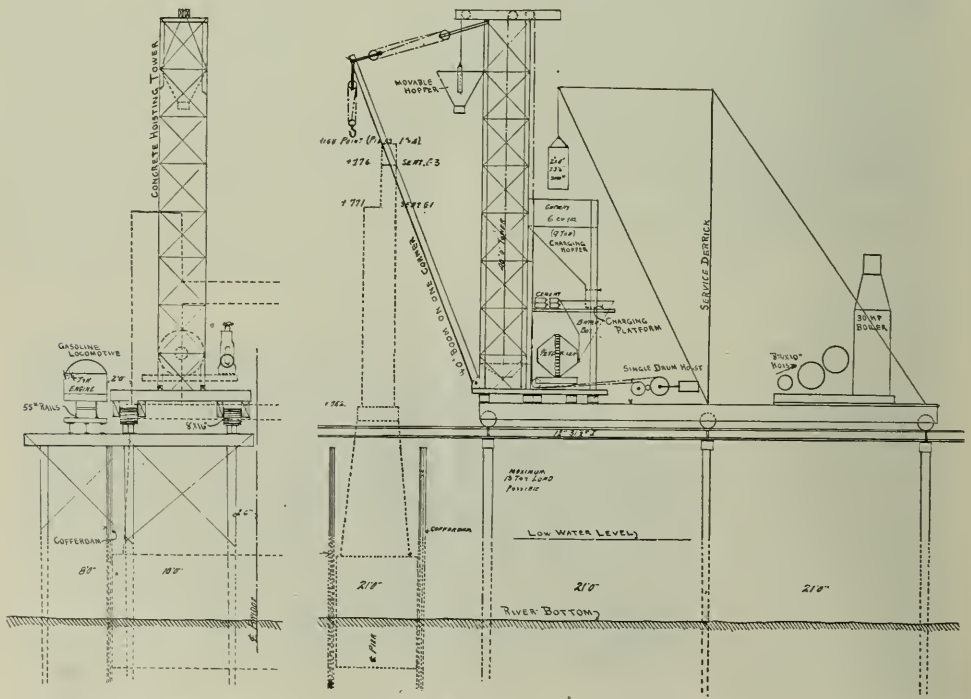
CONCRETE PLANT.

The concrete plant was installed on a platform about 44 feet long and 14 feet wide mounted on six 16-inch double-flange drum wheels or rollers on the 10-foot gage service track. On the extreme forward end of the platform there was installed the wooden hoisting tower 40 feet high, and in the rear of it a 3½-yard concrete mixer set underneath the hopper-bottom storage bin, which was filled with aggregate by a stiff-leg derrick mounted in the center of the platform, and operated by a double-drum hoisting engine, which, with its 30-h.p. vertical boiler, was installed at the rear end of the platform and served as a counterweight for the hoisting tower and its 40-foot boom, which hauled the concrete bucket and the concrete forms and served for general purposes.

Lumber and cement were delivered on the narrow-gage track to the forward end of the platform and the cement was stored on a charging platform over the mixing machine, which was supplied with a fixed hopper-bottom batch box charged by gravity from the 9-ton storage bin above. The mixed concrete was delivered to a bucket in the tower that was hoisted by a line from a 5x5-inch single-drum hoist. The concrete was discharged from the hoisting bucket to a moveable hopper suspended from an overhanging end of the tower cap and thence spouted through steel chutes for a maximum distance of 65 feet, or delivered to the bucket handled by the boom which swung it to position and dumped it into the pier forms. This equipment proved very satisfactory and the substructure work was carried on with it and an average force of 60 men.

STEEL ERECTION.

The steel was delivered on the tracks of the



CONCRETE PLANT, WITH HOISTING TOWER, HOPPERS AND DERRICK BOOMS, FOR HANDLING AGGREGATE, CONCRETE AND FORMS, ALL TRAVELING ON FALSEWORK CARRYING SERVICE TRACK ALONGSIDE.

TRAVELING DERRICK WORKING AT COFFERDAM.

Chicago, Milwaukee and St. Paul railroad, which passed under Span No. 1 with a clearance of 22 feet. It was unloaded by a derrick car of 40 tons capacity which delivered to the traveler that erected it. The heaviest pieces handled were the main girders, 79 feet long weighing 10 tons each. The 79-foot spans were erected at the rate of four per week by a gang of 14 men and the rivets were driven at the rate of 360 per four-man gang per eight hour shift.

The principal quantities involved were 498 tons of structural steel, 94 tons of reinforcement steel, 1,764 yards of concrete in the substructure and 517 yards in the superstructure, 341 foundation piles and 1,000 yards of rip rap.

Lower Road Construction Bids

Early bids for construction of Federal aid roads indicate that prices during the coming season will be materially lower than last season. Grading has been bid at 20, 23½ and 30c per cubic yard in Missouri, Arkansas and Minnesota respectively, as compared with an average of 35c for this section last year. Prices for reinforcing steel range around 6c as compared with 8 or 9c last year. A few bids for the best grade of concrete of about $17.00 per cubic yard have been received in sections where the 1921 price was about $25.00 per cubic yard. Prices bid for the construction of concrete roads per square yard are as follows: Oklahoma, $1.52; Colorado, $2.27; Georgia, $1.38, as compared with an average of $2.57 during the period 1916-1920.

DERRICK CAR DELIVERING STRUCTURAL STEEL FROM LOW-LEVEL RAILROAD TRACK TO BRIDGE GRADE

Building Zone Plan Growing Stronger

By Edward M. Bassett

The Greater New York building zone law has now been in operating over 5 years. The protective requirements are shown on 3 maps, known as height, area and use. The charter provides that changes in the maps can be made only be the Board of Estimate. The aggregate changes are extremely small in area, showing the remarkable permanence of the protection of the zoning system.

In the years 1916-1921, inclusive, 158 applications for changes were granted by the Board of Estimate and 134 were denied. These figures tend to show that changes are not easily obtained. This is as it should be, because when an owner builds according to the zoning requirements he ought to be protected against easy changes of surrounding requirements.

Of the total changes there were 4 in 1916, 43 in 1917, 26 in 1918, 20 in 1919, 27 in 1920 and 38 in 1921. It would appear from the figures that during the last 3 years the map changes were fairly proportioned to the normal growth and change of the city.

Use map changes were 143, area map 11, and heights map 4. It is quite possible that as the amount of new construction increases, more changes proportionally will be made in the area and height maps.

Figures show not only official support of the zoning plan, but they show clearly that property owners are gradually favoring the strengthening of the zoning requirements rather than their relaxation.

The building zone system of New York may be deemed a success. Other cities, which have recently adopted it or are preparing their maps, may well be encouraged by the experience of New York.

Rapid Construction of Concrete Bridge

On October 14th, a heavy rain storm caused a wash-out of a wooden bridge over a creek in Ohio county, W. Va. This bridge was on an important road between a prosperous farming community and the city of Wheeling and the immediate resumption of traffic was necessary. The following day, October 15, the board of commissioners ordered the bridge rebuilt of concrete as rapidly as possible and A. C. Hoffmann, the county road engineer, was given instructions to proceed with the work and he placed Campbell Savage in charge as foreman.

Arrangements were made for immediate delivery of sand and gravel and on October 16th, the wreck of the old structure was removed and forms built for one abutment and its wings. The following day concrete was placed in this abutment, resting on bed rock. The next day, the third of construction, the second form was built, and it was concreted on the fourth day. The fifth day, the slab form was erected and on the sixth day the steel reinforcement was placed and the slab concreted on the seventh day. Forms for the railings were built on the eighth day and the railings concreted on the ninth day. On the tenth day, the concrete surfaces were rubbed down and the forms and material removed from the site, leaving the work completed.

This was a 26-foot span bridge with a 30-degree

skew. The state highway department's standard plans were used. The slab is 22 inches thick, reinforced with four 12 by 3-inch steel eye-beams and two 12 by 3-inch channels taken from the old bridge. The working crew ranged from 2 to 11 men.

The Highway Contractors' Problems*

To secure less risk, better engineering and relations with engineers, fairer specifications, improved labor conditions, and others.

Perhaps the greatest problem of constructors relates to the education of themselves. This education should be conducted along the lines of cultivating skill, integrity and responsibility and eliminating the old time jealousy and distrust through encouragement of a spirit of co-operation and mutual helpfulness in every member of the industry.

It is good business for constructors to educate their competitors; it is good business for them to discuss each others problems, construction and administrative methods; it is good business to get each other's viewpoint, it is good business and elimination waste both to the contractor and others, to seek out the best means consistent with first class work and to assist in standardization of methods and equipment along those lines; it is good business to secure added protection by all legitimate means. Organized construction can best promote these things. Sane, honest and common sense competition is better for all interested in highways than the destructive, individualistic tendency which has so often, in the past, made highway construction a financial shambles and brought upon it disrepute as a business proposition.

Lower contract prices are imperatively needed to secure greater mileage of roads for the public. The greatest reduction which can be brought about would doubtless result if certain risks now assumed by the contractor were assumed by the State. A constructor can figure closely on work in direct proportion as elements of risk and uncertainty are eliminated. In many States the assumption of these elements of risk and uncertainty are required by the organic law and can only be escaped by access to public opinion as expressed through legislative action. To bring about a change in these laws which will facilitate a more balanced and equitable form of contract, through the elimination of the above elements, is the problem not only of the constructor but of engineers and all others interested in highway building, who desire decreased costs and better stabilization of the industry.

It is also the problem of the highway builder to use his influence to create a public sentiment which will countenance better paid and better qualified engineers and inspectors. Good constructors invariably find engineers and inspectors satisfactory in direct proportion as the latter possess integrity, intelligence and experience and that the employment of high class men will invariably justify itself in an ultimate saving to the taxpayers.

Another problem of the constructor is to co-operate in pointing out to the highway departments and engineers those requirements of the specifications which entail increased costs without any commensurate advantage and those requirements which can be waived in the interests of economy without sacrificing quality. The difficulty with commissions and engineers (as to many changes for which we are asking) lies not so much in their failure to recognize the just principle to apply as in finding a means to apply it practically.

One of our problems is to bring about a realization, by all engineers and inspectors, that the constructor is their partner and not their bondman in a great work.

In the matter of specifications, we believe it to be one of our problems to secure the settlement, by an impartial referee (when desired by either party) of disputes between ourselves and engineers as to the interpretation of specifications and matters of equity. Said William B. King, of the Washington bar:

"The engineer writes what, in his judgment, has a certain meaning. The easy evolution of authority to the architect or engineer to decide all uncertainties, directly encourages vagueness in writing specifications." An engineer, with every desire to be fair, will oftentimes interpret specifications too much in the light of what he had in mind to safeguard when he wrote or adopted the specification in dispute. The working out of standard specifications for the country as a whole will save much effort and expense for which the taxpayers now pay.

Uniform and fair treatment of labor and possibly more uniform wages and working conditions for the various classes of skilled labor employed upon highways are believed to be a problem from which benefit can be derived. If it were possible to develop some co-ordinated industry in the northern and border states, whereby highway labor might be retained the year around upon some productive work, constructors would be able to secure greater economy and added efficiency from their organizations. Co-operation between concerns working in the same locality, in the matter of labor, will go far towards stabilizing conditions and creating greater efficiency.

One problem relates to the working out of a form of contract with material producers which will be a standard for the industry and more binding upon both contracting parties. The experience of many constructors with material contracts, during the war and post-war period, had a direct tendency to increase contract prices.

Another problem is the matter of responsibility for rejected material. Some producers refuse to accept responsibility for material condemned after unloading, while some engineers refuse to make final inspection until the material is unloaded. Uniformity of practice and understanding in this matter will remove an element of anxiety and loss to many constructors and will, doubtless, reflect itself in lower contract prices.

In the matter of transportation, our chief problem is to assist the railroads, and indirectly the public, in

*Excerpts from paper by Henry H. Wilson before the Good Roads Congress.

the elimination of waste and expense, by so designing work and unloading facilities as to provide for prompt release of cars.

Standardization of equipment holds great possibilities for efficiency and economy and organized construction is already moving in this direction.

One of our greatest problems lies in our relations with the surety companies. It is believed that a reduction in the cost of highway construction can be effected through a reduction by the surety companies of the premium now charged for contract bonds; and it is believed this reduction will be justified by a more careful investigation upon the part of the Surety Companies, of contractors whom they bond. Within the past ten years there has been an increase of approximately 100 per cent. in bond premium and, within the past thirty years, the increase has been comparatively greater.

Jefferson County's Road System*

By E. M. Wheeler

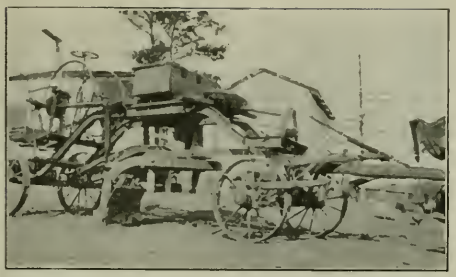
Equipment used for road work, cost and efficiency of convict labor, and cost of truck operation and maintenance.

The total equipment available for road work consists of 10 tractors and 28 motor trucks, in addition to scrapers and graders. With one exception the trucks are all 3½ ton, this size having been found best suited to the work to be done. The tractors range from the Fordson up to larger machines, and include the Avery, Twin-City, Hart-Parr, and Rumeley. Several makes of trucks are used, including the White, Federal, Mack, Government, and Standard. Five new Government trucks are about to be added to the equipment.

One of the most efficient machines is an Avery one-man road machine, equipped with a 12-foot blade. This machine will scrape 12 miles of road in one day, at a cost of 10 gallons of gasoline, 2 quarts of oil, and the time of one man.

*Concluded from page 300.

MOTOR TRUCK AT CAMP NO. 1.



MULE-DRAWN ROAD SCRAPER, CAMP NO. 1.

Maintenance is mainly eternal vigilance in small things. The roads are watched very closely and not allowed to get in too bad shape before corrective measures are applied. Such measures differ with the condition of the roads. When not too badly worn, the road is scraped and reshaped by machine. When the road is worn so that this is not possible, the holes are filled with new material, and the surface scraped and reshaped. Where a highway is obviously beyond such methods, it is scarified, three or four inches of new material added, and the road entirely remade. This is necessary about once in two years.

The cost of convict and free labor necessary to do the work is about $233,000 a year. A part of this would be spent under any circumstances in maintenance of the prisoners, and their food and clothing costs would remain about the same, whether working or idle. The roads of Jefferson county represent an expenditure of about $6,000,000, so that the money spent for maintenance is a comparatively small sum. And yet, by the spending of this sum, the citizens of the county are enabled to enjoy the benefits of a real system of good roads.

The efficiency of convict labor in comparison with free labor has been the subject of much discussion. Until the first of 1922, Jefferson county maintained free labor camps in addition to the convict camps, so that a direct comparison is possible. During 1921, free labor was paid $2.50 per day for road work, and required to maintain themselves. Usually the foreman maintained a camp and commissary, charging the men for the board and sleeping quarters. The cost to the county per day of work was $2.50.

Convicts work only in good weather, but they must be fed, guarded, and maintained at all times. The cost of convicts during 1921, in six camps in the county, varied from $1.65 to $2.35 per effective day of work, averaging, for all camps, $1.98 per effective day. The work days, by the way, were 66 per cent. of the feed days, showing a fairly good working efficiency, which is much higher than can be maintained with free labor.

It is the opinion of the department that convict labor, when properly worked, with good foremen, has as much value as free labor. Whatever advantages free labor may have in "will to work" is overcome by the uncertainty of securing enough labor. "Laying off" works havoc with the efficiency of any construction job. There is no such trouble with convict labor. The convicts are not paid except for Sunday work around the camp.

The costs for various items in connection with the maintenance of the convicts at the camps are given herewith. Items for the individual camps are omitted, owing to a slight difference in the accounting methods used by the various foremen, and only general averages are given. It may be stated, that with the going into effect of various economies with the beginning of the year, it is expected that the costs for 1922 will be materially lower than those for 1921, the costs for which follow:

Cost of Maintaining Convict Camps, 1921.

Groceries	$31,922.35
Clothing	13,811.89
Camp maintenance	21,381.54
Guard pay roll	30,698.15
General expense	27,278.25
Total	125,092.18
Groceries for free labor	4,991.46
Convict maintenance	$120,100.72
Convict work days	60,535
Convict idle and yard days	31,796
Guard days	11,776
Free labor feed days	18,599
Total feed days	122,706
	Cents
Cost per day for food	.26
Cost per convict work day, total	$1.98
Cost of convict clothing per month	4.48
Cost of convict camping per month	6.95
Cost of guarding convicts per month	10.96

It may be of interest to note that the mules in the various camps cost 53 cents a day for food and that they worked 79 per cent. of the time, so that the cost per effective day of work was about 65 cents.

The total cost of maintaining the prisoners and of operating the road equipment was $233,091.61. Two hundred prisoners were on hand the first of 1921, and 286 at the end of the year.

It is not possible to get work from prisoners unless they are, to some degree at least, satisfied with their living conditions. Every effort is made to keep the camps in first class sanitary condition, and to make them fairly comfortable. Good, wholesome food is served in clean dining rooms. The kitchens have to pass the inspection and receive the approval of the county board of health. Vermin are kept out of the camps by strict compliance with sanitary rules, and by frequent fumigating. Prisoners are not chained in the cell, which is a large, long, one or two-room building, wide enough to contain a double row of beds, end to end, with a passage-way in the middle. Double beds are used. Airing and cleaning of the bed clothes are required at regular intervals. Shower baths are provided and the prisoners required to bathe at regular intervals. White and colored prisoners are kept in different camps.

A new system of accounting was installed the first of the present year, by means of which more accurate costs on certain phases of the work will be available. Some time has been necessary to educate the foremen of the various camps in the new requirements, but accurate costs are now becoming available. The accompanying table shows the cost for repairs, oil, gas, drivers, per ton, and per mile, for February.

Plans for the future include the possible formation of a grading gang, made up from present equipment. Mules are not economical on road maintenance work as compared with tractors. Four small tractors at less than $3,000 total cost will take care of the same amount of work as mules worth $7,000. With the acquisition of these four tractors these mules could be used efficiently on grading work, and it is believed that such work could be done by county forces at a considerable saving in cost over present prices.

The road work in Jefferson county is directly under the Board of Revenue, of which D. C. Ball is chairman, and W. B. Copeland, Lacey Edmundson, Jerry Gwin, and Thos. E. Huey are members. Claude J. Rogers is county highway engineer, and the writer is superintendent.

Jefferson County Truck Report for the Month of February, 1922.

Trucks.	Gas. Oil and Reprs.	Driver.	Total.	No. da. Worked.	No. Mi.	Mi. Oil and Gas.	Tons.	Cost Mi. T.	
5½-ton	89.87	61.55	52.50	203.92	15	637	.14	1220	.17	Camp 2
3½-ton	55.13	436.04	38.50	529.66	11	622	.09	985	.54	Camp 5
3½ ton	91.81	18.75	77.00	187.56	22	1279	.07	2276	.08	Camp 4
3½-ton	78.08	245.86	52.50	376.44	15	974	.08	1782	.21	Camp 4
2-ton	55.79	40.26	56.00	152.05	16	682	.08	752	.20	Camp 6
2 ton	52.91	104.51	70.00	227.42	20	549	.10	873	.44	Camp 2
2-ton	54.93	2.38	73.50	130.81	18	873	.06	878	.15	Camp 1
3½-ton	70.03	54.29	56.50	190.82	19	942	.07	1683	.12	Camp 4
3½-ton	65.20	130.50	42.00	237.70	12	616	.11	1000	.24	Camp 2
3½-ton	52.29	179.77	38.50	270.56	11	496	.11	915	.29	Camp 4
3½ ton	159.48	77.83	63.00	300.31	18	621	.26	807	.37	Camp 7
3½-ton	81.90	90.20	59.50	231.60	17	930	.09	1722	.14	Camp 4
3½-ton	79.47	1.61	73.50	154.58	21	858	.09	1473	.11	Camp 2
3½-ton	72.16	86.91	73.50	232.57	21	1467	.05	2327	.10	Camp 5
3½-ton	74.60	13.30	73.50	161.40	21	1139	.07	1617	.10	Camp 5
3½-ton	50.13	243.58	42.00	325.71	12	527	.09	677	.49	Camp 3
3½-ton	40.38	165.87	52.50	258.75	15	483	.08	553	.47	Camp 3
3½-ton	75.70	313.76	66.50	456.06	19	1146	.07	1995	.23	Camp 5
3½-ton	57.60	118.32	70.00	245.92	20	722	.08	1055	.23	Camp 3
3½-ton	100.85	184.81	70.00	355.66	20	1019	.10	1816	.20	Camp 2
3½-ton	78.28	135.71	70.00	283.99	20	1291	.06	2141	.13	Camp 5
3½ ton	77.63	39.45	70.00	187.08	20	1034	.08	1499	.12	Camp 1
3½-ton	60.52	57.98	63.00	181.50	18	796	.08	1269	.14	Camp 2
3½-ton	89.56	67.85	70.00	227.41	20	981	.09	1625	.14	Camp 2
3½-ton	81.67	42.92	66.50	191.09	19	1149	.07	1886	.10	Camp 1
	1,846.07	2.914.00	1,550.50	6,310.57		21,833	.08	3,4516	.18	

PUBLIC WORKS

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Plans for Sewerage and Water Works

Most large engineering offices have found it desirable to standardize many of the features of the plans and maps prepared by them. The adoption of two or three standard sizes of sheets greatly facilitates filing; the placing of title, scale and explanation of symbols at the same relative position on each sheet expedites finding the one desired; the standardizing of symbols minimizes the probability of error in using and interpreting them; and there are a number of other features the standardizing of which will aid greatly in the efficiency and economy of the work of the office.

In connection with any special branch of engineering it is conceivable and even probable that there are standards for the various features that are best adapted to plans relating thereto and that should, therefore, be adopted by all engineers; such as scale of map, scale of detail plans, and symbols. To a certain extent this has been done; topographic symbols, for example, are pretty well standardized.

Such general uniformity is especially convenient for those who have to deal with the plans of a number of engineers, among which are state boards of health and of public service. Both of these state boards can require, in most states, the filing of plans of sewerage systems and of water works, and there would, therefore, seem to be considerable justification for their requiring engineers doing work in their respective states to conform to standards such as have been referred to. In fixing such standards, however, the board should adopt those in most common use so as to necessitate the minimum of change in the previous practice of the engineers.

Such conformity to standards is required, or in some cases only suggested, by a number of the states, two of which are referred to in this issue. On the other hand, a number, perhaps the majority, do not specify the size or form of plans and maps but only require that they furnish the necessary information.

In the matter of information furnished there is also a difference in practice. Most of the states specify in general the kind of information required, but others go much further and specify in great detail the several headings and sub-headings to be used in the engineer's report as well as the matters to be shown on the maps, plans and sections. An illustration of the latter is Arkansas, an abstract of whose regulations on this point is given in this issue. These regulations name twenty-two classes of information that "shall" be given by reports on sewerage systems. The California board names twenty-nine headings for a report on sewerage, but states that "Its scope is indicated by the following suggested headings, but it must include a discussion of other important considerations, whether listed here or not. These headings are suggestive only."

It seems to us that a health board should not go further than to *suggest* the exact form in which a report is to be drawn up. We would prefer even that these suggestions be not contained in the body of the regulations, since the fact that they are only suggestions might be overlooked; but they might better be printed on a separate folder.

Certainly engineers who have had years of experience in preparing plans and writing reports of this kind do not need such suggestions, and should not be asked to suppress their initiative and follow a stereotyped form which might lead to failure to assign a proper perspective to the several major and minor elements of the problem. But, on the other hand, engineers young in this work would undoubtedly be glad of such aids, and be less likely to overlook important questions that should have an influence on the design.

Wages and Public Works

Apparently wages are now down about to the level of the latter part of 1917, and are still falling slowly, so that the average for this year will probably be about that for 1917, or 40 per cent. higher than 1914. In the eastern States, outside the large cities, plenty of labor can be had for 25 cents per hour or less—even below 20 cents in Philadelphia; while in the southern States 13 to 15 cents was being paid a few weeks ago. On the Pacific coast, where labor has always received the highest wage, 45 to 50 cents was common quite recently.

Carpenters' wages and those of other mechanics

have not fallen so much as those of common labor in the sections of cheap labor, such as the south Atlantic States, but have reached 40 to 60 cents in most States east of the Rocky Mountains.

Altogether, since there have been considerable reductions in labor and cement and prices for many other materials are reasonable, the indications are that public work can be done this year at a price that will stimulate such activity as has not been seen since the war.

Water Power Licenses

The Southern California Edison Company has been granted by the Federal Power Commission a license to develop an important project on the San Joaquin river. It is planned to install machinery capable of developing 195,000 horsepower. A dam 100 feet high is to be erected. The power will be fed into the company's transmission line which supplies power to Los Angeles. Another license was granted the Portland Railway Light and Power Company of Portland, Oregon. This covers important developments in Clackamas County, Oregon.

Cleaning Canals and Laterals With a Disk Harrow

A recent number of Reclamation Record contains an account of the method pursued by water master Geo. Haycock for cleaning moss and weeds from the canals and laterals of the Minidoka Irrigation Project, Idaho, by means of a disk harrow.

The banks and bottom are sometimes covered with a heavy blanket of moss and with long, slender weeds that sometimes obstruct the channel so much as to cause the water to overflow the banks and to do considerable damage besides reducing the flow. Various methods have been tried for the removal of the growth and the use of a submarine saw and men wading in the shallow water and cutting with scythes were the most satisfactory, but were slow and expensive.

The use of an ordinary farm disk harrow was found ineffective, but when the harrow was modified by the use of a special semi-circular frame connecting the disk to the drawbar and permitting the machine to be swung transversely at the several different angles, very satisfactory results were obtained. The machine was hauled by two wire cables, each operated by a team, one team on each bank of the canal.

The main canal 20 to 25 feet wide and the laterals 8 to 10 feet wide at water line, were cleaned by a machine and a crew consisting of foreman, two teamsters, two teams and one laborer. This outfit averaged one mile per day of canal and 1¾ miles of laterals, at a direct cost of $18.50 per day exclusive of overhead. The average cost per mile for canals and laterals was from $15 to $17 while the same work done by hand cost $82.50 per mile.

About 17 miles of canal were cleaned with very satisfactory results, and after the water was drawn off an inspection showed that the canal was in excellent shape for next season's work without further cleaning. It was estimated that without this operation it would have been necessary to move about 10,000 cubic yards of silt from the cleaned portion of the canal, which was thus handled at a cost of about 3¼ cents per cubic yard. The principal objection to this method of cleaning is that it causes weir and orifice holes to fill up; but as these have to be cleaned occasionally in any event, it is not a serious matter as compared to the cost of silt removal.

Comments on Imhoff Tanks

Madison, Wis.

Editor of Public Works:

Dear Sir: In accordance with your request I am herewith submitting my views and observations on the Imhoff Tank, after reading the excellent article by Mr. Riker, and the discussions which followed. I can add but little to what has been said in Public Works by these men or to what I have published in other periodicals.

One tendency, which I think we all have, is to write what we think, what we assume happens in a tank or that which we would like to have happen, rather than what actually does happen. These ideals seldom, if ever, come true.

After reading these papers and others along the same lines, together with my experience with Imhoff tanks, I offer the following as a brief summary of principal facts and ideas affecting the operation of the Imhoff tank.

Imhoff Tank Operation

1. Age of sewage—relatively stale better than fresh sewage for Imhoff tanks.
2. Grease and oils—American sewage more than German causes scum on upper chambers and sludge in gas vent.
3. Viscosity of sludge holds down gas and is factor in foaming.
4. In large plants, tanks nearest inlet receive less sewage and grease, but more heavy sediment and are less liable to foaming, but scum will be more pronounced.
5. Too small gas vents or large ones restricted by scum, increase tendency to foaming.
6. Liberation of gas by frequent drawing of sludge or stirring tends to prevent foaming and scum.
7. If fresh material is brought into contact with stale, bacterial reduction will be greater and sludge reduction more pronounced.
8. Aeration of sludge by air lift pumps is beneficial.
9. Imhoff tanks on effluent of sprinkling filters do not foam.
10. Manner of making slot and position of the baffle or "V" affects amount of scum on upper chamber.
11. Slopes of hoppers have not been sufficiently steep or smooth enough. The minimum should be 1 to 1.3.
12. No concrete or other permanent covers should be placed over Imhoff or similar tanks. Where possible, housing is preferable.
13. Most troubles are due to design, mismanagement and gross overloading.
14. Advantage of Imhoff tank is its automatic separation of liquid and solids. This separating can be done mechanically at additional cost, but with the assurance that some troubles will be eliminated.

Remedies for Existing Plants

Put in mechanical stirer in sludge digestion chamber or circulate sludge from tank operating correctly into foaming one. Draw off small quantities of sludge frequently rather than large ones at long intervals.

From Mr. Coulter's discussions one might conclude that it would be a desirable thing to "Blow off" the digestion chamber above the sludge level as soon as indications of foaming are noticeable. This could be readily accomplished in divers manners.

New Plants, if Tanks Must Be Used

Use plain sedimentation tank with steep hopper bottoms, provide means to draw off sludge constantly as by air lift pumps or frequently by other means so as to keep primary tanks in fresh condition. Digest sludge in separate tank or dewater by mechanical means.

Yours truly,
W. G. Kirchoffer, San. & Hyd. Engr.

Gilboa Dam Construction*

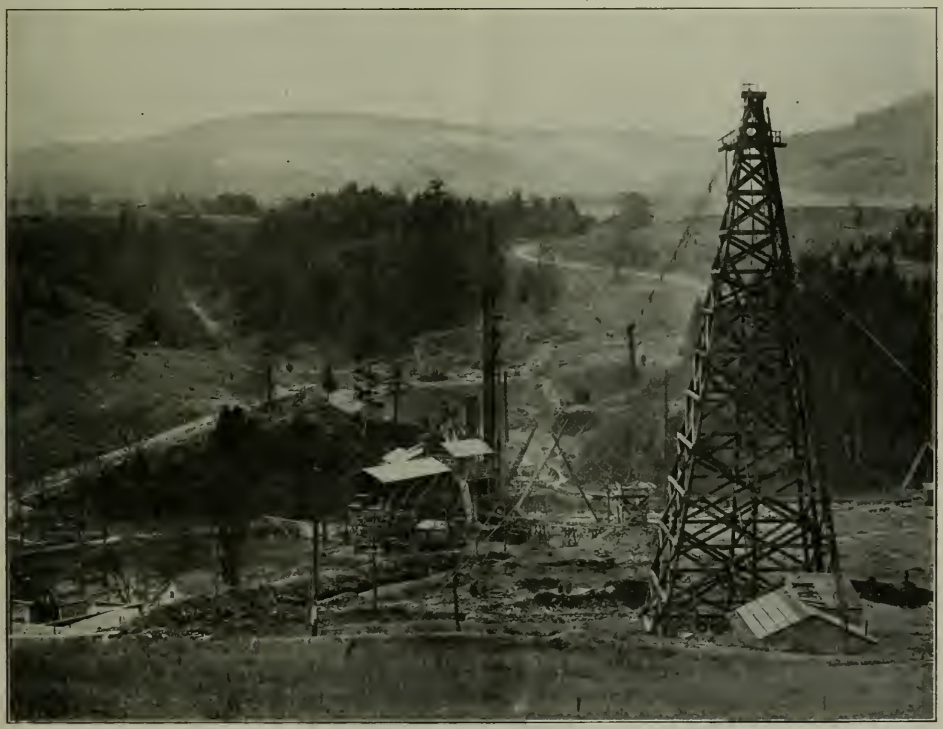
Steenkill dike and appurtenances. Foundation, excavation, controll channel, steam shovel and belt conveyor work for large embankment, bypass pipes and flume, repairing culvert and paving slope.

The west end of the 2,300-foot long masonry structure of the Gilboa dam across Schoharie creek is extended about 730 feet by a short transition section and a little more than 600 feet of an earthen dike, curved in plan, which is 34 feet wide at the top and about 445 feet in maximum width at the bottom, with a concrete core wall which is carried down to offset foundations on the rock bottom and crosses the former Steenkill channel. The top of the dike will be about 20 feet above the flow line of the reservoir, and about 150 feet above the lowest part of the original surface of the valley. The construction involves a foundation excavation of about 40 feet in maximum depth. The embankment contains about 600,000 cubic yards of earth.

*Part I—Exploration borings, pressure tests, river diversion, foundation excavation and installation of plant was published March 25th.
Part II—Quarries, sand pits, washings and screenings, concrete mixing and placing was published April 29th.

The Steenkill water was temporarily bypassed through the lower part of the Steenkill dike by a concrete culvert until the core wall and embankment had been carried up to a height of about 30 feet, permitting the water to be diverted through a control channel across a tongue of land to the bed of the Schoharie creek above the main dam; after which earth and sand were sluiced into the culvert through pipes left for the purpose in the roof, solidly filling the culvert, which was then imbedded in the embankment which, as it was carried higher, extended a considerable distance beyond both ends of the culvert.

Subsequently the water of the Steenkill was passed through the cofferdam in the steel bypass pipes until the masonry reached a sufficient elevation to permit the pipes to be sealed and the water to be diverted through a tunnel left in the masonry, to be eventually closed after the dam is completed and the



GENERAL VIEW OF DAM SITE, SHOWING MAIN CABLEWAY, SAND PLANT AND CONCRETE INSTALLATION DESCRIBED IN PART II.

engineers are ready to impound the waters and fill the reservoir.

Work on the excavation of the Steenkill control channel was commenced in the spring of 1921 with a pick and shovel gang, supplemented by a drag scraper operated by a hoisting engine to move the material back from the channel.

The invert of the channel, 10 feet wide, was widened to 20 feet at the approach and outlet and was protected with 18 inches of broken stone pavement extended over the 1:2 side slope. The channel was about 300 feet long with a grade of approximately 20 per cent., and was provided with four cut-off walls, one at the top, one at the bottom, and two at intermediate points of the slope.

Paving stone and concrete stone from the main dam excavation were delivered by wagons or loaded in skips or buckets handled by a derrick and relayed by it to a stiffleg derrick on top of a knoll that dumped them into 1-yard side-dump cars operated by a hoisting engine over a 2-foot gage track extending from top to bottom of the control channel.

The paving closely followed the excavation and as soon as 40 feet of the invert had been paved, the side slopes were started and the paving was flushed with 1:3 grout mixed in a 1-bag machine discharging into a mortar box, from which it was dipped by pails and poured in place by hand. The work was carried on rapidly enough so that little separation of the cement and water in the grout resulted, and the final application was made with a thicker grout than was used for the first application.

The cut-off walls were concreted with a 1:2 1-3:4 2-3 mixture made in a 1-bag gasoline operated machine delivering to a chute through which the concrete was spouted to place.

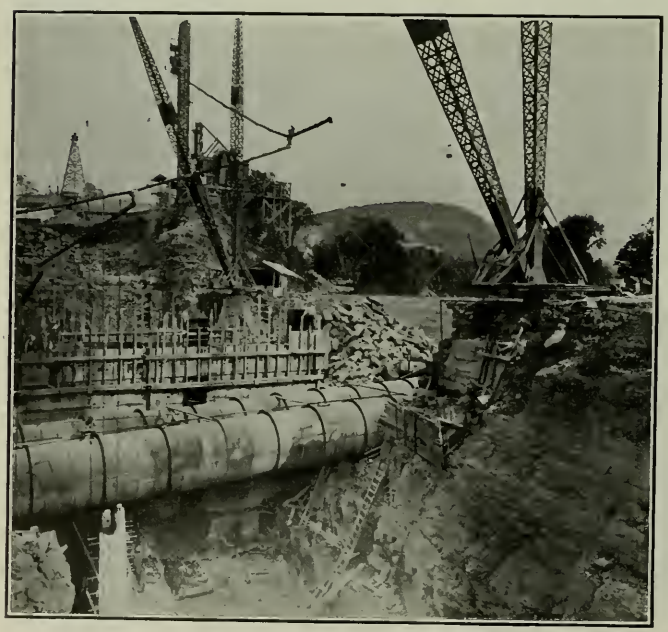
EMBANKMENT CONSTRUCTION.

The construction of the dike embankment was commenced by placing a small amount of suitable material provided by the excavation for its foundations, but was mainly carried on with very lumpy red and yellow clay excavated by an Atlantic No. 45 steam shovel from the top of an adjacent hill; loaded at the borrow pit into trains of two 4-yard cars hauled by a dinky locomotive to a dumping hopper which discharged onto a 600-foot belt conveyor which delivered the clay at the lower end to a loading hopper near the concrete bypass culvert. Wagons drawn by teams passed under the hopper, were loaded, and transported the clay to required position on the embankment, where it was dumped and spread by horse-drawn grading machines, finished by hand and compacted in 4-inch layers by a steam roller. As the work progressed the lower end of the belt was raised and moved longitudinally of the embankment until eventually the conveyor was higher than the top of the embankment and the material was chuted to position.

CRACKS AND DISPLACEMENTS.

When the embankment had been made up to a height of about 55 feet above the lowest point of the original surface of the ground, at the east end of the dike, cracks developed, and an investigation showed that the ground under the embankment was slipping transversely on the underlying blue clay stratum. The bank was therefore narrowed at this point with hope to arrest movement by decreasing the load. The cracks were sealed at the surface by pouring in sand and grout, and operations were suspended at this end of the dike, the embankment having been brought up to a maximum height of about 76 feet for a length of 250 feet.

The lower end of the dike was protected by a wooden flume extending to the paved control channel and preventing the accumulation of water pressure against the face of the dam at this point. For a length of 60 feet the flume was 12 feet wide and 8 feet high, beyond which the height of the flume was reduced to 5 feet. The flume was built with 2-inch longitudinal planks covered with tar paper protected by 1-inch boards and spiked to transverse bents 4 feet apart on centers. Each bent having two 6x8-inch vertical posts and an 8x8-inch sill long enough to receive the feet of 2x8-inch outside inclined braces. The tops of the posts were tied together over the flume by 2x8-inch planks. At the upper end of the flume there was built a wing wall or braced wooden bulkhead, extending below the surface, to form a cutoff.



BYPASS PIPES CARRYING FLOW OF STREAM THROUGH COFFER-DAM. DESCRIBED IN PART I.

To support the downstream side of the dike and the unstable stratum below it, additional embankment material was placed to bring the level up above that of the blue clay stratum. To prevent the accumulation of water against the downstream face of the dike the lower end of the culvert was connected to a pair of 24-inch cast iron pipes 250 feet long which were laid in concrete to carry the flow away from the embankment.

Late in the fall of 1921 a freshet produced a greater flow in the culvert than could be carried by the 24-inch pipes and resulted in rupturing 22 feet of the culvert at the outlet end, where gravel and driftwood were brought down by the flood, blocked the end of the pipe, and backed up the water until it flowed over the dike, washing away some of the last placed material, but doing comparatively little damage to the dike.

The upper end of the culvert was closed with stop planks, the gate was shut, and water impounded above the dike while the culvert was drained with a 6-inch electric centrifugal pump and a 6-inch duplex pump, permitting the entrance of a wheelbarrow gang which cleared away the obstructions at the entrance to the cast iron pipes.

A 14½x26-foot area surrounding the broken portion of the culvert roof was enclosed by 2-inch sheeting, and excavations and repairs were made there, the stop planks removed, and the culvert opened and used to draw off the water impounded above the dike.

As the work on the embankment progressed, the force was increased from one to two and finally three shifts, and the belt conveyor was supplemented by a narrow-gauge double-track railroad 250 feet long with a grade of 8½ per cent. and carried for 200 feet over a timber trestle. The tracks extended from the end of the belt conveyor and on them were operated a pair of 4-yard cars connected to opposite ends of a cable carried around a regulating drum at the upper end that determined the speed and permitted the full car descending to pull up the ascending empty car.

PAVING.

In September 1921 the protection of the upstream slope of the dike was commenced by covering it up to elevation 1,050, about 60 feet above the original lowest ground surface, with three feet of rip-rap. Above that elevation there is being laid a pavement of 18 inches of large stones, procured from the dam excavation and delivered by cableway to the west end of the dike, where they are handled to place by a stiff-leg derrick on top of the dike leg. The very large stones are laid on their beds, but the remainder are set on edge and all are covered with 6 inches of crushed stone. Up to the end of 1921 about 1,250 cubic yards of paving had been laid.

The principal items of plant installed for the construction of the Steenkill embankment include one Atlantic type, class 45 steam shovel with 2½-yard buckets at the borrow pit; one 12-ton Austin roller; one 15-ton dinky locomotive at the borrow pit; two 30-h.p. vertical boilers; two 2-drum hoisting engines at the channel diversion; one single-drum hoisting engine; 1,100 feet of narrow gauge railroad track; one hand crab derrick at the river diversion; one 22-inch belt conveyor 600 feet long.

Refuse Collection in Paterson

Amounts collected and itemized costs of collecting, hauling and incinerating. Horse-drawn wagons, gasoline trucks and electric tractors used.

As has been the case for several years past, H. J. Harder, city engineer of Paterson, N. J., kept during 1921 quite complete records relating to the collection and disposal of ashes and garbage in that city—a practice which is far too uncommon in American cities.

The amounts of refuse collected per month varied from a minimum of 2580 in February to a maximum of 5500 in June, the total for the year being 57,381. The average number of electric tractors per day in use varied from 2.8 in February to 4 during seven months of spring, summer and fall. The average number of loads collected by them per day was 5 every month except 5.1 in February, 5.3 in March, 5.4 in April and September and 5.1 in October. The tractors had a capacity of 10 tons and the average amount collected varied from a maximum monthly average of 10.57 tons to a minimum of 9.57. The cost of labor employed in collecting by electric tractor varied from a minimum of 37.49 cents per cubic yard to a maximum of 48.25 cents, averaging for the year 41.08 cents.

The current used by the tractors cost $1,176.28 for the year or 2 cents per cubic yard. Maintenance of the trucks cost $3,726 or 6.49 cents per cubic yard. The overhead was $6,000, making the total cost $34,483 or 60 cents per cubic yard. The maintenance cost for February was more than 25 per cent. of that for the entire year and the total cost for that month averaged 91¼ cents, the highest average cost per month for the remaining 11 months being 55.35 cents.

Part of the collection was made with horse-drawn wagons, the teams being hired. February, the month during which the least number of electric tractors were used and the highest amount of repair charges were incurred, was also the month during which the greatest number of horse-drawn wagons were in service. During this month the average number of wagons in service was 22.66, while during the summer months only 7 or 8 wagons were in use. The horse-drawn wagons averaged from 5.4 loads per day in July to 8.46 loads in January, the amount carried by each load averaging slightly more than 3 cubic yards. The number of men per wagon averaged slightly less than 2, apparently from 1 to 3 of the wagons going out with only 1 man. The cost for teams and labor averaged 64.04 cents per cubic yard, which was the total cost, as the teams were hired and there was no cost for maintenance or supplies.

Gasoline trucks also were used of two sizes, 5 cubic yards and 10 cubic yards capacity. Two of these were used in December, January, February

and March and three during the other months of the year. These trucks made 6 trips during June, July, August, September and October, 7 trips during April and May, 7.8 trips in February, 8 trips in November and December, 8.37 in March and 8.50 in January. In general there were 4 men to a truck, although in December, January and March 5 or 6 men were used per truck. The total cost of collection by gasoline trucks was 5.45 cents per cubic yard for labor, 5.9 cents for gasoline, 9.97 cents for maintenance and 78.73 cents per cubic yard including an overhead of $14,000.

The garbage was hauled to a destructor plant and the ashes to dumps. In maintaining the dumps there were employed an average of from 7 men in January to 12½ men in December. The total cost for labor on the dumps averaged 9.4 cents per cubic yard deposited there, the total number of yards deposited on the dumps having been 142,193. Other costs in connection with the dumps averaged 0.96 cents per cubic yard, giving a total cost of 10.36 cents for maintenance of the dumps.

Combining all costs, this gives a total cost for the 176,769 cubic yards removed of $130,828, or 74 cents per cubic yard, this including overhead.

Of the material collected 34,576 cubic yards was incinerated. The cost of operating the incinerator was $12,914 for wages and $3,031 for maintenance, a total cost of maintaining and operating the incinerator of $15,945, or 46.11 cents per cubic yard.

Carting clinker from the destructor plant was quite an item, the cost of this service for the year having been $2,392, of which $284 was for wages, $1,958 for team hire and $150 for maintenance. The material incinerated produced 2,807 cubic yards of clinker and the cost of removing this was therefore 85.21 cents per cubic yard of clinker removed, or 6.9 cents per cubic yard of material incinerated. In this case the clinker, instead of being an asset as it is sometimes claimed it will be in advocating destructor plants, was a liability to the extent of about 7 cents per yard of material incinerated.

LINCOLN HIGHWAY.

Sixty miles of the Lincoln Highway, between Boone and Carroll, has been put in fine shape and smoothly graveled, with the result that the buses operating between these cities, each of which holds twenty passengers, will operate the year around, making three trips each way every day. The service starts with two buses, and it is expected that more will be added rapidly.

The expenditure during 1921 on the Lincoln Highway between New York and San Francisco, which was at first estimated to have been $6,500,000, is now stated to be more than $9,400,000.

The construction of the 30-mile Ridge Route Highway in California cost $1,500,000, and it is conservatively estimated by state authorities that this road effects an actual saving to motor vehicle users of $6,000 daily, so that in the first year the road paid for itself.

Engineers' Plans for State Health Boards

Regulations of the State Boards of Alabama, Arkansas and California with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits.

Some of the state health boards have adopted detailed instructions to engineers concerning the forms in which plans and other descriptions of proposed water and sewerage works must be submitted to them, while others leave this largely to the engineers themselves. It is impracticable to quote the detailed instructions but an effort is made to give in this and following articles abstracts of these instructions. Those interested in the requirements of any particular state board can undoubtedly obtain copies of the instructions on application.

Alabama. The law requires "complete plans and specifications and a statement containing a general description of the proposed water supply system, or of the proposed changes in the existing system, showing the geographical location thereof with relation to the source of water supply, and the manner of storage, purification or treatment proposed,—and all the sanitary and health conditions surrounding and affecting said supply and the works, system and plant." The board does not further specify the form of reports or the scale and size of maps and plans.

Arkansas. The Arkansas requirements are very specific as to plans. Plans must be submitted at least two weeks prior to the date upon which action by the board is desired.

For *water works* there must be submitted:—

(a) A general plan of the municipality or district, showing the proposed system.

(b) Detailed drawings showing construction of any special structures in the distribution system.

(c) General and detailed plans for the water purification works.

(d) A comprehensive report upon the proposed system by the designing or consulting engineer. This report to be written upon letter-size paper and the sheets firmly bound together. A preliminary report, containing data and information sufficient for the complete understanding of the project may be sub-

mitted to the State Board of Health for their consideration, prior to the submission of detailed plans.

The map must be drawn to a scale not greater than 100 nor less than 300 feet to one inch, covering the entire area are to be supplied. If the area exceeds two miles in any direction the map may be divided into sections, bound together, with a small index map. Detailed instructions are given as to what this map must show (streets, elevations, pipes, valves, hydrants, etc.) Detail drawings must be furnished, preferably on sheets 20 or 31 inches high and 24, 32, 40 or 48 inches long. The titles must contain name of municipality or other owner and of engineer, date, scale and explanation of symbols, etc.

An engineer's report is required, giving all data upon which the design is based or that may be required for complete understanding of the plans. "If no purification process is provided, the nature and extent of the water shed, with special reference to its sanitary condition, shall be fully and explicitly discussed, together with proposed methods and regulations for the prevention of accidental or other pollutions." Specific, detailed information must be given concerning wells or collecting galleries, the purification plant, pumping plant, the population to be served, and other elements of the problem; and specifications and estimate of cost.

For *sewerage systems* there must be furnished a map of the municipality or district, profiles of all sewers proposed, details of appurtenances, plans of disposal works, and a comprehensive report, typewritten on letter-size sheets firmly bound together. A preliminary report may be submitted prior to the submission of the detailed plans. In general, only plans for the separate system of sewers will be approved. The requirements for the map as to scale are the same as for water works. It shall show contours at intervals of not more than 10 feet and elevations at street intersections; location of existing and proposed sewers; average elevation of water in streams and direction of their flow, elevation of highest known freshets at outlets, etc. Sewers to be built at present shall be shown by solid lines; sewers to be constructed later, by dashes; existing sanitary sewers by dots and existing combined sewers by dots and dashes. The topographical symbols are to be those of the U. S. Geological Survey. Elevations of streets should be placed outside the street lines in the upper right angle or opposite their positions. Elevations of sewer inverts should be shown at street intersections and wherever a change of grade occurs, written between the street lines. Surface elevations should be shown to the nearest tenth of a foot and sewer elevations to the nearest thousandth. All appurtenances shall be shown by suitable symbols.

For profiles the scales recommended are 10 feet to 1 inch vertically and the same scale as the map horizontally. Profiles are to show manholes, flush tanks, lampholes, siphons and stream crossings; figures indicating sizes and gradients of sewers, surface elevations, sewer inverts. Plans under profiles should show lot and street lines, locations of Y's, cuts, etc.

As minimum grades there are suggested a fall for 100 ft. of 0.60 feet for 6-inch sewers; .40 ft. for 8-inch; .29 ft. for 10-inch; .22 ft. for 12-inch, etc., and if lower grades are used an explanation is required. Each profile sheet is to contain an index of the streets appearing on that sheet, and sheets are to be numbered consecutively.

Detail plans are required of sections of sewers other than clay or iron and of all appurtenances; of the disposal works and of a disinfecting plant. The last shall show longitudinal and transverse sections of each unit, distributing and drainage systems, etc.

The dimensions suggested, except for the map, are the same as for water works.

The report shall give all data upon which the design is based, including a description of the area to be sewered; population, present and 25 years hence; estimated daily flow of sewage; present water consumption; allowance for leakage; character of sewage; method of flushing; minimum grades; treatment of sections too low to drain by gravity; list of bench marks. The description of the disposal plant is to cover the method adopted, rate of operation of each unit, provisions for reserves, dry-weather flow of stream receiving effluent, disposal of sludge, local conditions affecting the design, special devices, kind of disinfectant and rate of use, maintenance and operation.

There shall be submitted specifications and estimate of cost giving unit prices; except that specifications may be omitted when extensions are to be made under specifications previously filed.

Applications for approval of plans shall be made on blanks furnished by the board.

The above is one of the most elaborate and detailed sets of instructions, as that of Alabama is one of the most general and brief.

California. The requirements of California resemble in general those of Arkansas, modified to suit local conditions. For example, under water supply, more attention is directed to dams and reservoirs. In these instructions more detailed attention is given to water purification and sewage treatment. The latter require, in the case of tanks, a statement of the average settling period, maximum velocity of flow through, provision for reversal of flow, discussion of excessive gas formation, sludge removal, mosquito nuisance, short circuits when tanks are pumped, area of sludge beds per capita, frequency of dosing filters. If disposal is on land, the acreage and application rate, kind and depth of soil strata, ground-water level, underdrainage, "provision for management of farm, responsibility for its management, provisions for rest and cultivation, crops to be grown, disposition of such crops, disposition of sewage in wet seasons, possibility of sewage reaching any stream or body of water at any time of year," must be described.

The other states will be considered in alphabetical order in future instalments of this series of articles.

Extensive Highway Construction

The North Carolina State Highway Commission has planned for one thousand miles of roadwork to be placed under contract this year. During the first two months of 1922 approximately 235 miles were contracted for in January and February, as follows: Sand clay, topsoil, and gravel, 125 miles; macadam, including all types, 28 miles; concrete, plain and reinforced, 30 miles; asphaltic concrete, 52 miles. The cost of work under contract or under construction had passed the $20,000,000 mark early in March.

Highway Work Done During 1921—Continued

County and State	Money spent for highway work	Kinds and amounts of highway construction
New York		
Cayuga	634,625	13 mi. conc., 17 bitum. mac., 11 W. B. mac.
Chautauqua	100,000	Rein. conc.
Niagara	600,000	14 mi. conc., 12 mac., 25 stn.
Oswego	610,000	28.9 mi. bitum. mac.
Schenectady	138,000	2 mi. bit. mac., 4 W. B. mac. 3½ bit. mac. incomplete
Schuyler	42,960	5.54 mi. rein. conc.,4.99 to let
Tompkins	201,000	.....
Yates	400,000	Bitum. mac.
North Carolina		
Bertie	45,000	Soil roads maintained
Forsyth	300,000	Conc. & top soil
Graham	22,000	.....
Lenoir	1,400,000	35 mi. sheet asph. on 5-in. conc. base
Mitchell	.....	5 mi. conc. contracted, 2 built
Surry	.....	Sand-clay
Washington	75,000	None
Wilson	121,479	Gravel $26,000; top soil $25,000
Yancey	175,000	Grading only
North Dakota		
Barnes	136,000	8 mi. gravel $16,000
Cass	150,000	8 mi. gravel
Grand Forks	143,763	½ mi. conc., 8 mi. light gravel surf.
Grant	120,000	10 mi. w. bridges, $70,000, (100 mi. earth $20,000), bridges, $30,000
Hettinger	200,000	7.92 mi. fed. aid proj.
McKenzie	15,000	Maint. & repairs
Mountrail	200,000	Dirt surf.
Ward	94,472	Earth $40,000, gravel $46,000
Williams	90,000	90 mi. earth rd.
Ohio		
Allen	270,000	2 mi. W. B. mac., 2 Willite on mac., 2 mi. mac.
Ashland	625,000	14.5 mi. brick, 2½ asph.
Ashtabula	660,000	6 mi. cinder., 22.2 mi. bituminous mac.
Fairfield	405,000	3 mi. tar bit., 2 mi. brick
Fulton	286,860	Conc. & W. B. mac.
Hancock	950,000	Conc., asph., asph. conc. & mac.
Hardin	200,000	2.08 mi. Ky. rock asph., 25 mi. bit. mac., 6 stone
Holmes	461,300	9.4 grad. & bridges, 2.88 gravel, 1.17 asph., 5.08 conc., 2.67 brk., 1.75 mac.
Logan	285,000	15 mi. gravel, 2 stone, 3½ conc.
Meigs	64,000	3 mi. tar-bound mac., ¾ conc.
Mercer	400,000	$275,000 conc., $100,000 stone & gravel
Ottawa	281,000	Conc.
Pickaway	60,000	Resurf. tar mac.
Pike	103,673	12 mi. gravel, 8 mi. conc.
Putnam	235,000	.....
Sandusky	450,000	10 mi. brk., 1 conc.
Shelby	360,000	6 mi. conc., 22 gravel & loose stone
Williams	500,000	4 mi. Willite, 4 bit mac., ½ conc., 6 W. B. mac., 3 Ky. rock
Oklahoma		
Carter	550,000	18 mi. gravel, 6½ Telford resurf., 10 sand-clay, 2 oil
Ellis	17,000	15 dirt rds.
Garfield	300,000	4 mi. conc. with Topeka top
Grady	215,000	Earth surface & clay on sandy places
Jackson	64,500	Sand clay, $1,500
Major	6,000	Earth grading
Oregon		
Grant	130,000	10 mi. dirt rds., 18 mi. graveled, surf. only
Marion	950,000	Conc., asph. conc., mac. & gravel
Pennsylvania		
Delaware	65,000	$25,000 new Tarvia rds.
Erie	700,000	Rein. conc.
Jefferson	200,000	2 mi. conc., 2 mi. graded, & 3 mi. former wk. completed
Lackawanna	145,000	Conc. rds.
Monroe	.....	10 mi. conc. $750,000, 1 mac. $6,500
Warren	400,000	8 mi. conc.
South Carolina		
Aiken	25,000	Sand-clay & gravel
Anderson	1,850,000	248 mi.—10 mi. asph. conc., 238 top soil
Cherokee	30,000	Top soil
Chesterfield	96,000	21 mi. gravel, 9 top soil
Greenwood	163,560	30.1 mi. top soil, 0.264 mi. conc.
South Dakota		
Clay	152,000	All dirt
Codington	90,170	34 mi. earth
Custer	250,000	6 mi. crushed granite, rest dirt
Day	245,008	28 mi. gravel, 5 earth
Douglas	27,392	27 mi. blade grad., 50,000 yds. fills, 6 mi. graded for gravel
Faulk	.....	10 mi. dirt.
Gregory	210,000	3 mi. covered magnesia
Haakon	110,000	Dirt road
Hanson	146,000	gravel, $85,000 gravel, $25,000 bridges, balance dirt
Jackson	27,000	130 mi. dirt rds.
McCook	75,000	Dirt—will gravel 60 mi. this year
Meade	120,366	None
Miner	32,246	72. mi. clay surf.
Roberts	125,000	38 mi. dirt graded; $33,000 bridges
Spink	.....	12 mi. gravel surf., $5 earth, 3 graveled
Sully	110,000	Earth; $35,000 bridges
Yankton	172,098	40 mi. earth, 3 gravel
Tennessee		
Bedford	100,000	W. B. mac.
Bradley	7,000	None
Claiborne	125,000	15 mi. W. B. mac., 10 grad.
Cocke	50,000	$6,000 gravel surf, $20,000 W. B. mac.
Coffee	20,000	Gravel
Cumberland	3,000	None
Grundy	10,000	None
Hamilton	300,000	4 mi. cem. conc., 20 asph. oil surf.
Hawkins	300,000	Grading
Lewis	38,000	10 mi. graded rd, 5 chert surf.
Montgomery	90,000	4 mi. mac. oil surf., 3 mi. penetration, 8 gravel
Moore	25,000	W. B. mac.
Rutherford	380,000	12 mi. pen. w. Telford base
White	135,000	11 mi. surf., 3 mi. base, 6 mac.
Williamson	60,000	Mac., gravel, earth
Texas		
Aransas	33,416	22 mi. shell, 10 sand clay, 14 earth graded
Colorado	50,000	Gravel
Comanche	92,400	$92,400 gravel, incl. grad. & bridges
Johnson	1,000,000	90 mi. gravel
Madison	70,000	10 mi. earth rd.
Newton	10,000	None
Rockwall	450,000	$300,000 conc. rd., $150,000 earth rds. & bridges
Smith	800,000	6 mi. conc., 70 gravel
Tarrant	2,000,000	$350,000 conc., $650,000 rock asph., $200,000 asph. pen., $800,000 gravel., incl. structures
Wichita	1,000,000	30 mi. 18-ft. conc.
Wise	38,000	5 mi. shell gravel surf., incl. grad. & structures
Virginia		
Augusta	452,000	40 mi. W. B. mac.
Fairfax	200,000	5 mi. bit. mac., 5 gravel
Halifax	100,000	Soil only
Scott	200,000	5 W. B. mac., 50 mi. graded
Washington		
Asotin	70,000	7 mi. crushed rock, 8 grad.
Clallam	200,000	20 mi. gravel
Douglas	27,000	3.1 mi. graded, $10,000; 11 resurf. gravel, $17,000
Grant	250,000	38 mi. gravel surf.
Grays Harbor	950,000	10 mi. conc., 6½ mi. plank, rest gravel
Island	45,000	3 mi. gravel
Jefferson	160,000	7 mi. gravel rds.
Lewis	521,884	4.1 mi. 18-ft. conc., $142,863
Lincoln	339,000	33 mi. crushed gravel and crushed rock
Okanogan	176,000	Gravel surf.
Pierce	500,000	25.86 mi. conc.
San Juan	5,010	8,000 ft. 9-in. gravel
Snohomish	500,000	6.5 mi. 20-ft. 1-course conc., $120,000; 15 mi. grad. & gravel, $100,000; maint., $200,000; bridges, $80,000
Whitman	619,552	$231,903.66 for mac. surf.
West Virginia		
Broxton	161,477	Grad. earth rds.
Brooke	409,194	28,161 sq. yds. conc., 17,601 gravel, 15,840 mac., 32,854 pen. mac., 32,854 cinders
Hancock	130,111	3.86 mi. brick, 1.52 conc.
Kanawha	600,000	Grading

Highway Work Done During 1921

County and State	Money spent for highway work	Kinds and amounts of highway construction
West Virginia (Continued)		
Mason	150,000	2½ mi. conc., 5 gravel
McDowell	400,000	Ky. rock asph. & grading earth rds.
Mineral	165,920	10 mi. earth rds., 2 surf. with shale
Monongalia	520,000	Conc.
Polk	60,000	Dirt & gravel
Upshur	142,000	3.5 mi. conc.
Wyoming	125,000	Dirt
Wisconsin		
Adams	80,000	15 mi. clay, 1½ gravel
Brown	1,210,000	27 mi. conc. rds., 30 gravel surf.
Buffalo	141,620	Shale covered with sand & gravel
Fond du Lac	776,238	17 mi. conc. 20 gravel
Forest	166,500	Earth & gravel
Grant	339,271	23¼ earth, 7 gravel, 1 conc.
Jefferson	630,000	8½ mi. conc., 12 gravel, 4 grad.
Juneau	127,871	30 clay, 5 gravel
La Crosse	491,616	142,872 sq. yds. tar mac.
Lincoln	171,483	38 mi. grad., 13 gravel
Monroe	308,000	$76,000 shale, $175,000 grad. & shaling
Price	188,000	$20,000 gravel
Sawyer	97,000	18 mi. grad. & gravel
Vernon	348,000	3½ mi. Tarvia pen. 18 ft. wide, 19 mi. earth
Walworth	946,050	24 mi. conc., 18.1 mi. gravel
Waukesha	150,000	Conc. pav. & gravel
Winnebago	644,777	$469,743 conc., $3,541 gravel, $34,594 mac.
Wyoming		
Lincoln	120,000	2½ mi. gravel surf., 40 graded bridges
Weston	45,000	75 mi. tractor graded, 3 earth

Wage Increases in Recent Years

The tendency of the war period in the United States has been to greatly decrease the purchasing value of the earnings of relatively high-salaried people and to increase that of the mechanic and laborers; mechanics' wages generally keeping on a par with the increase of living and those of unskilled laborers gaining considerable increase over the 1915 to 1922. It shows a wide variation of the actual amount of wages paid and a great reduction from the peak of 1920.

Another diagram of wages in the same geographical sections shows the percentage of changes as compared with cost of living. In all but one of the districts, increases went higher than the cost of living during 1920, in all of them the wages were above the cost of living in 1921, and except in the Pacific section they have now dropped below the cost of living. (The wages are actual, while the cost of living is assumed or theoretical, and is probably taken on a basis of high theoretical standards, which is not in the diagram differentiated for separate districts, but is some kind of average for them all and thus may not show fair comparisons in all cases.—Ed.)

Present wages and before-the-war wages for mechanics and building workers are shown in the tables giving hourly wages for common labor and twelve different kinds of skilled labor in five principal typical cities in widely separated portions of the country, as determined by the United States Department of Labor. From it, the Associated General Contractors of America concludes that "it is clear that the wages now being received by some of the trades enable them to buy more of the good things of life than they could with the pre-war wages, while in other cases the present wage will purchase a considerable poorer living than the wage which ruled in 1914.

"Workers in the building trades in Washington, D. C., have thus far been decidedly more successful than those in other places in boosting their effective wages above the pre-war standards. Everyone of the twelve Washington grades shown in the diagram are receiving wages which, in purchasing power, are considerably in excess of the wages prevailing in 1914.

"The present wages shown in the table for Chicago are those established by the Landis decision."

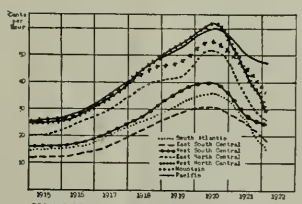
Comparative Table of Wages in 1914 and 1922

	Boston			Baltimore			Chicago			Los Angeles			Washington		
	Wages per Hour		P.C. of 1914	Wages per Hour		P.C. of 1914	Wages per Hour		P.C. of 1914	Wages per Hour		P.C. of 1914	Wages per Hour		P.C. of 1914
Artisans:	1914	1922	Wages	1914	1922	Wages	1914	1922	Wages	1914	1922	Wages	1914	1922	Wages
Plumbers	.650	.900	138	.500	.937	187	.500	.787	157	.563	1.125	200	.313	.594	190
Bricklayers	.650	.900	138	.625	1.250	200	...	...	...	.375	1.125	300	.256	.594	232
Plasterers	.650	.900	138	.625	1.250	200	.700	.950	136	.438	.875	200	.500	1.000	200
Struct. Iron Workers	.625	.900	144	.563	.950	169	.650	1.000	154	.500	1.000	200	.500	1.050	210
Cement Finishers	.625	.900	144	...	...	...	...	...	...	.500	1.000	200	.600	1.060	177
Stone Cutters	.563	.900	160	.500	1.000	200	...	...	...	.563	1.062	189	.500	1.000	200
Laborers	.350	.575	164	...	...	...	...	...	...	.344	.550	154	.250	.425	170
Sheet Metal Workers	.550	.900	164	.400	.800	200	.625	1.025	164	...	...	...	.540	1.000	185
Electricians	.550	.900	164	.438	1.000	228	.650	.850	131	.600	1.000	167	...	...	...
Carpenters	.550	.900	164	.438	.800	182	.680	1.050	155	.500	1.000	200	.625	1.250	200
Painters	.525	.900	171	.375	.800	213	.750	1.100	147	.750	1.250	167	.625	1.250	200
Hod Carriers	.350	.600	172	.313	.750	239	.750	1.100	147	.750	1.250	167	.667	1.250	185
Plasterers' Helpers	.407	.700	172	...	...	...	.750	.950 .600	127	.563	1.125	200	.562	1.050	189

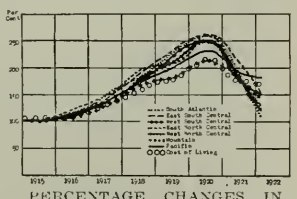
cost of living, which increase in some cases has been retained and in some cases has been largely lost.

One of the accompanying diagrams shows the curves of the wages paid common labor in road construction on Federal Aid Road Projects in different geographical sections of the United States from

*Abstracted from data presented in Index published by Association General Contractors. Washington, D. C.



WAGES OF COMMON LABOR IN FEDERAL AID ROAD WORK SINCE 1914.



PERCENTAGE CHANGES IN WAGES OF COMMON LABOR IN FEDERAL AID ROAD WORK COMPARED WITH COST OF LIVING.

Recent Legal Decisions

BRIDGING TEMPORARY DEFECTS IN SIDEWALKS

In an action for personal injuries against a city, it was held, Wasson v. City of Sedalia (Mo. App.) 236 S. W. 399, that two boards "laid over" a ditch a foot wide and a foot deep, in the brick pavement, which warp and sag into the shape of a hog trough, and do not remain in position, are not ordinarily reasonably secure; but an instruction which covered the case and directed a verdict for the plaintiff, without submitting the issues of whether the sidewalk was rendered dangerous and not reasonably safe, and of whether the city had constructive notice thereof a reasonable length of time before the injury sufficient to have enabled it, in the exercise of ordinary care, to remedy the situation, was held reversible error.

NECESSITY FOR CERTIFICATE FOR STREET WORK PERFORMED—STATUTORY OR COMMON LAW BONDS

Where a contract for street grading provides for payment of monthly installments for the work "as shown by the certificate of the street committee." the Washington Supreme Court holds, Smith vs. Town of Tukwila, 203 Pac. 369, that the contractor could not recover such installments without such certificates unless they had been unfairly withheld. A statement by a member of the committee to the town council as to the amount due the contractor would not suffice.

It was also held that if the state statutes providing for a bond for public works do not compel the municipality to exact the bond therein provided for, or provide that any other bond will be without effect, and the town takes a common-law instead of the statutory bond, the bondsman will be liable thereon, on the contractor's default.

MUNICIPAL REGULATION OF SIGN BOARDS IN STREETS

The Oregon Supreme Court holds, City of Portland vs. Yates, 203 Pac. 319, that if a sign in a street in front of property, which has been properly constructed under a permit issued in pursuance of an ordinance, should become objectionable or unsafe, or under changed conditions should interfere with the use of the street or sidewalk, and it becomes necessary, in the exercise of the police power, to remove it, the city would have authority to take proper proceedings to abate the nuisance, or remove the obstruction. Stated differently, the public right in the street is paramount, and the abutter's right to proper use of the street in front of his property is subject to reasonable municipal and police regulation.

JURISDICTION OF BOARD OF PUBLIC WORKS IN ORDERING STREET IMPROVEMENTS

A board of public works, as authorized by a general street improvement ordinance, adopted an ordinance ordering certain street improvements to be done under its supervision. Subsequently the latter ordinance was repealed. It was held, in an action to foreclose a street assessment lien, Fay Improvement Co. vs. Nelson, 203 Pac. 417, that this did not deprive the board of jurisdiction to pass another ordinance ordering the improvements to be made, in the absence of a showing that anyone was or would be injured by the delay in ordering and proceeding with the improvements.

MINORS NOT EXCEPTED FROM STATUTORY REQUIREMENT AS TO NOTICE OF INJURIES

The Colorado statute requiring notice of time, place and cause of injuries to be given within 90 days from the occurrence of an accident for which compensation is sought from a city as a condition precedent to recovery is mandatory; and the Circuit Court of Appeals, Eighth Circuit, holds, Baker vs. Town of Manitou, 277 Fed. 232, that failure to give notice is not excused because the injured person is a minor, and was confined to bed for the whole period of 90 days. Under statutes similar to this, it has been held that it is not the province of courts to make exceptions where the legislature has made none. Peoples vs. City of Valparaiso, 178 Ind. 673. Ellis vs. City of Kearney, 80 Neb. 51.

OREGON STAUTE AUTHORIZING ORDINANCES REGULATING KEEPING OF DOGS HELD VALID

The Oregon Supreme Court holds, Hofer vs. Carson, 203 Pac. 323, that Oregon Gen. Laws 1919, p. 273, authorizing the passage of ordinances for the summary destruction of unmuzzled dogs without notice to the owner is not unconstitutional as depriving the owner of his property without due process of law, although dogs are recognized as property under the Oregon statutes. The provision of the statute authorizing cities to provide dog license fees to create a fund to reimburse owners of sheep and other domestic animals in the county for losses sustained through the death or injury of such animals caused by dogs is held not unconstitutional as granting special privileges to the owners of such animals, the act merely requiring the owners of dogs to make good the ravages of dangerous animals kept by them.

WATER RATES CHARGEABLE BY MUNICIPALITY NOT SUBJECT TO REGULATION BY CALIFORNIA

Following the decision of the California Supreme Court in City of Pasadena v. Railroad Commission, 192 Pac. 25, the California Court of Appeals, Second District, holds, Johimsen v. City of Los Angeles, 202 Pac. 902, that section 23 of article 12 of the Constitution of California, giving the Railroad Commission power and jurisdiction to supervise public utility and fix rates therefor, was not intended to and does not vest in the Railroad Commission authority to regulate the rates to be charged by the city of Los Angeles in the sale of water to its inhabitants. The section of the Constitution does not deny the equal protection of the laws to public utilities, though construed as inapplicable to municipally owned public utilities, for the reason that a municipality engaged in the business of furnishing water for public use is not engaged in such business under the same conditions as those pertaining to a private corporation or person furnishing water to the public.

NEWS OF THE SOCIETIES

CALENDAR

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 9—SOCIETY OF INDUSTRIAL ENGINEERS. Auditorium Hotel, Chicago.

May 9-11—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. Atlantic City, N. J.

May 12—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

May 15-16—FLORIDA ENGINEERING SOCIETY. Daytona, Fla.

May 15-19—AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting Washington, D. C.

May 17—UTAH SOCIETY OF ENGINEERS. University Club, Salt Lake City.

May 17-18—LEAGUE OF TEXAS MUNICIPALITIES. Annual convention. Waxahachie, Tex. Secretary, F. M. Stewart, University of Texas, Austin.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE, Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines, Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff. 60 State St., Boston, Mass.

June 6-8—CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

SOCIETY OF INDUSTRIAL ENGINEERS

A meeting of the Society of Industrial Engineers will be held at the Auditorium Hotel, Chicago, on May 9. Subject, "Stabilization of Labor."

AMERICAN WATER WORKS ASSOCIATION

Annual Convention May 15, Bellevue-Stratford Hotel, Philadelphia. Group Meetings: 1. Office records, methods, accounts, etc. 2. Pumping station, engines, boilers, firing, etc. 3. Filter plant, operation, care, etc. 4. Pipe laying, methods, records, etc. 5. Services and meters, material of services, laying, meter setting, reading and care. 6. Water sheds and reservoirs, care, algae treatment, tree planting, etc. 7. Private fire protection services. Especially inter-connection with polluted sources and the efficiency of double check valves on such services.

Evening—President's address; reception and dance, Clover Room.

May 16, Forenoon Session—Announcement of officers elected for 1922-1923; general and new business; report of Publication Committee; report of Finance Committee; "Philadelphia Water Supply, Present and Proposed" (lantern slides), George W. Fuller; "Fire Prevention and Fire Protection in Relation to Public Water Supply," Frank C. Jordan.

Afternoon Session—"Development of the Schoharie Watershed, Catskill Water Supply" (lantern slides), J. Waldo Smith; "The Hetch Hetchy Water Supply" (lantern slides), M. M. O'Shaughnessy; "Construction of the Loch Raven Dam," Wm. A. Megraw; "Twenty Years' Filtration Practice at Manufacturers' Association Program. Albany, New York," G. E. Wilcomb.

Evening Session—Water Works Manufacturers Association Program Moving Pictures showing 20,000 H. P. of high steam pressure being discharged to atmosphere and shut off in 30 seconds by Dean Control. Description by Peter Payne Dean; "Underground Leakage and Its Relation to Mains and Services," Thomas F. Wolfe; "Pneumatic Pumping, Up-to-Date" (lantern slides), John Oliphant.

For the Ladies—Trip to Valley Forge, auspices Water Works Manufacturers Association.

May 17—Theatre party.

May 17, Forenoon Session—Reports of Special Committees: "Standard Form of Contract," J. Waldo Smith, chairman; "Standardization Council," George W. Fuller, chairman; "Industrial Wastes in Relation to Water Supply," Almon A. Fales, chairman; "Water Shed Protection," Theodore DeL. Coffin, chairman; "Problems in the Reforestration of Water Sheds" (lantern slides), George R. Taylor; selection of place for holding the 1923 Convention.

Afternoon—Trip by Delaware River boat to Wilmington and return.

Evening Session—"Some Observations Concerning Wood Pipe," J. W. Ledoux; Report of Committee on Standard Specifications for Cast Iron Pipe and Specials, F. A. Barbour, chairman; "Experience with Cast Iron Water Pipe for Pressures Higher than Allowed by Current Specifications," C. E. Inman; "Centrifugally Cast Iron Pipe," Peter Gillespie, motion pictures and lantern slides.

May 18—Trips to points of local interest and evening card party.

May 18, Forenoon Session—Superintendents' Day. (See p. 308, issue of April 29.) "Water Chlorination Control in Virginia (practical demonstration of control test), L. N. Enslow; report of Committee on Physical Standards for Distribution Systems, G. Gale Dixon, chairman; "Air and Relief Valves," M. M. Borden; "Instances of the Value of a Sanitary Survey," W. P. Mason; "Causes of Failure of Cast Iron Pipe," F. A. McInness; "Topical Discussion of Breaks in Water Mains and on General Subjects."

Afternoon Session—Equipment and Shop Facilities for Maintenance of Water Works Systems" (lantern slides), George E. Cripps; Topical Discussions; "Present Day Tars for Pipe Coatings," W. R. Conard; Topical Discussions, Water, Chemical and Bacteriological section.

Evening Session—"Purification of Water for Industrial Uses" (lantern slides), S. T. Powell; "Lime, Soda and Zoelite Water Softening," A. S. Behrman; "Tubo-Centrifugal Pumps" (lantern slides), Richard Waller. Smoker held in the Bellevue-Stratford Hotel.

May 19, Forenoon Session—Joint session with Chemical and Bacteriological Section. "Plant Control of Chlorination by the Excess Chlorine Method as Employed in New York City's Water Supplies" (lantern slides), Frank E. Hale; "Responsibility of the Water Works Superintendent to Prevent Tastes and Odors Due to Microscopic Organisms" (lantern slides), Wm. W. Brush; "Further Notes on Chlorine Control at Grand Rapids," W. A. Sperry; "Recent Practice in the Removal of Odors by Aeration, Filtration and Other Processes," Norman J. Howard; "Recent Developments in Chlorination" (lantern slides) Wm. J. Orchard.

Afternoon Session—Report of Committee on Meter Schedules, Standardization of Slides, Allen Hazen, chairman; "Steel Pipe," Theodore A. Leisen; "Steel Pipe," G. A. Elliott; "Design, Construction and Operation of a Balancing Reservoir" (lantern slides), Wm. A. Megraw.

Chemical and Bacteriological Section

May 18, Afternoon Session—"Water Softening by Base Exchange," Edward Bartow and Gerald C. Baker; reports of Standards Committees; "Standard

Methods of Water Analysis," Jack J. Hinman, Jr., chairman; "Colloidal Chemistry in Relation to Water Purification," Robert Spurr Weston, chairman; "Testing of Water Works Materials and Supplies," Thaddeus Merriam, chairman.

May 19, Afternoon Session—Symposium on Tastes and Odors: "The Effect of Wastes from Oil Refineries Upon the Operation of the Filter Plant at East Chicago," H. E. Jordan; "Some Observations on Chlorine Tastes and Odors," Wellington Donaldson; "Tastes and Odors from Decomposition and putrefaction of Organic Material in the Maumee River Water" (lantern slides), F. Holman Waring; "Chlorination Prior to Filtration, with Special Reference to Efficiency, Economy and Removal of Excess Chlorine" (lantern slides), Norman J. Howard; "Reactions of Culture Media," George C. Bunker and Henry Schuber.

BROOKLYN ENGINEERS' CLUB

At the informal library talk for Thursday, April 20, by John V. Hogan, consulting engineer of New York, and Fellow and Past President of the Institute of Radio Engineers and Member of the American Institute of Electrical Engineers, addressed the club on "Radio Telephony; What it is, and Commercial and Popular Applications," illustrated with lantern slides and an installation for receiving concerts from broadcasting stations.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

The sessions of the annual meeting will be held Friday, May 12, in the Assembly Hall of the Automobile Club of America, 247 West 54th street, New York City.

Program—Report of National Committee on Uniform Highway Signs, chairman, Elmer Thompson, secretary Automobile Club of America; report of National Committee on Traffic Capacity and Widths of Highways Outside of Municipalities, chairman, Herschel C. Smith, assistant professor of Highway Engineering and Highway Transport, University of Michigan; report of National Committee on Status of the Construction of Highway Curves and Recommended Practice to Increase Safety to Traffic, chairman, H. Eltinge Breed, consulting highway engineer, New York City; report of Executive Committee on Highway Improvement Creed of the National Highway Traffic Association; annual reports of the secretary, treasurer, executive committee and the board of directors; report of National Committee on Regulations Covering Speeds, Weights and Dimensions of Motor Trucks and Trailers, chairman, George H. Pride, president Heavy Haulage Co., of New York City; report of National Committee on License Fees and Motor Vehicle Taxation, chairman, Henry G. Shirley, chairman Good Roads Board, American Automobile Association; report of National Committee on Highway Transport Franchises, chairman, F. W. Fenn, secretary National Motor Truck Committee, National Automobile Chamber of Commerce; report of National Committee on Highway Transport Clearing Houses, chairman, Tom Snyder, secretary National Association of Commercial Haulers, Indianapolis.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular business meeting, May 3, a paper entitled "The American Mixed-Flow Turbine and Its Setting," by Arthur T. Safford and Edward P. Hamilton, was presented. This paper was published in April "Proceedings," and sketches completely the early development of hydraulic turbine practice in this country. Preceding this presentation a short moving picture film of the Dayton meeting was shown.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The spring meeting of the American Society of Mechanical Engineers will be held in Atlanta, May 8-11. Preliminary events took place at Charlottesville, Va., on May 6 and 7, in co-operation with the Virginia section of the A. S. M. E. Immediately following the Atlanta meeting observation tours will be made to points in the south, including Birmingham, Greenville, S. C.; Muscle Shoals and Pensacola, Fla.

EASTERN NEW YORK SECTION, A. S. M. E.

The Eastern New York section of the American Society of Mechanical Engineers held a meeting on April 4 at Schenectady. The meeting was addressed by President Dexter S. Kimball on "Engineering and Citizenship," and by Secretary Calvin W. Rice on "The Progress of the Professional Engineering Societies in Their Participation in World Affairs." A feature of the meeting was a ten-minute radio message sent by President Kimball from Station WGY at 8.30 p. m.

METROPOLITAN SECTION, A. S. M. E.

A joint meeting of the student branches in the Metropolitan district was held on April 7. The subject of the 4 p. m. meeting was "The Port of New York." The speakers were Elihu C. Church and George E. Roberts. This was followed by a buffet supper at 6 p. m., and entertainment from 7.30 to 8 p. m., when another meeting was held on the subject of the "St. Lawrence River Project." Speakers were H. I. Harriman and Dr. Harrison H. Wheaton.

METROPOLITAN SECTION, A. S. M. E.

A joint meeting of the Ordnance divisions, A. S. M. E., A. S. C. E., A. I. E. E. and A. I. M. E., was held on April 14th in the Engineering Societies' Bldg. The subject of this meeting was "The Muscle Shoals Development from an Economic Point of View." Motion pictures of Muscle Shoals development to date were shown and addresses were delivered by Brig. Gen. Harry Taylor on "Muscle Shoals as a Power Producer," C. W. Stowell on "Commercial Nitrates" and Gen. C. C. Williams on "Military Nitrates." The work of the Ordnance division, A. S. M. E., was outlined by Waldo Marshall.

PERSONALS

Stonebreaker, Henry B., has been appointed superintendent of the water department of Steubenville, Ohio.

Merrill, Leland G., city engineer of Parkersburg, W. Va., has resigned to accept a position with the West Virginia State Highway Commission.

Maney, Maurice H., of Dorchester, Mass., has been appointed building commissioner of the building department of the city of Boston.

Conant, E. R., has resigned as town manager of Mansfield, Mass., to become surveyor of the recently created highway department of Manchester, N. H., where he will have charge of street and sewer construction and maintenance, street cleaning and garbage collection and disposal.

Montgomery, Julian, city engineer of Wichita Falls, Texas, has resigned, and his assistant, F. M. Rugely, has been appointed to his position.

Ellison, J. T., chief bridge engineer of the Minnesota State Highway Department, has been appointed assistant state highway commissioner by C. M. Babcock, commissioner.

Dennis, John H., who has been with the state highway department of Michigan for many years, has been appointed county engineer of Genesee county, Mich.

Shoecraft, Ezra, city engineer of Flint, Mich., since 1913, has tendered his resignation, effective May 1.

Fuller, Harvey, city engineer of Chatham, Ont., has been appointed city manager. He will continue as city engineer.

Rowe, George H., assistant engineer of the board of public utilities of Los Angeles, Cal., has been appointed assistant engineer with the California State Road Commission.

Danielson, Frank D., formerly assistant manager of Glencoe, Ill., has been appointed village manager of Hinsdale, Ill.

Miller, David B., has been appointed city engineer of Michigan City, Ind., to succeed D. C. Ford, retired.

Schwarting, W. W., has been appointed General Superintendent of the Hibbing, Minn., city lighting, gas and water works, to succeed Charles Foster, resigned.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HEIL HAND HOISTS

The Heil Hand Hoist, manufactured by the Heil Co., is of very substantial construction, weighs only 290 pounds and occupies only 8 inches of the length of the chassis.

It has been designed to lift loads up to 5 tons. All of the working parts are incased to keep out dirt, it can be operated from the driver's seat and it is geared so that little effort is required to raise the loaded body in approximately one minute, one-half minute longer being necessary to dump the load. The dumping angle varies from 35 to 40 degrees; after dumping, the body returns to normal position by gravity, the downward movement being retarded by the brake.

The cable from the hoisting drum passes over sheaves on the cross head of the hoisting frame and thence to the arms attached to the outside of the dump body so as to secure direct and convenient operation and abundant clearance. The hoist can be mounted on any make of chassis and is quickly installed by the application of four U-bolts. The dump body can be locked at any intermediate point of its elevation, thus making it especially safe for road maintenance work where only part of the load dumps in one place.

HEIL HAND HOIST.

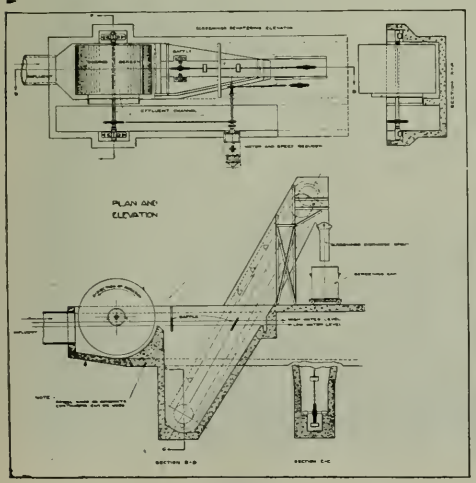
THE DORRCO SCREEN UNIT.

The Dorrco Unit, manufactured by the Dorr Company, removes larger suspended and floating solids in sewage or industrial waste water and is also adapted for removal at the intake of objectionable floating or settleable solids from water for public or private uses. It is claimed to remove probably from 8 to 24 per cent. of the solid suspended matter in sewage and to provide an efficient screening, which is usually the first step for sewage treatment.

The apparatus has been developed to secure the effective preparation of solid and liquid matter without clogging the screen and to dewater it and handle it for final disposal. It is self-cleansing without brushes, scrapers of jets, and combines efficiency with low cost for installation and maintenance and operation.

The screen is a partially submerged, horizontal, cylindrical, revolving drum, into which the screened sewage flows through perforations. The discharge opening is sealed to prevent unscreened sewage from by-passing the screening medium and the action of the screened effluent inside the drum causes spouting which positively cleans the screening medium and delivers the screenings to the screening pit. Where bulky solids are to be removed a lifting fin ejects these solids into the screening pit. The screenings are removed from the screenings pit by a slow-speed, dewatering elevator, which delivers them into cans or carts at a convenient point. The drum usually revolves at a circumferential speed of about 300 feet per minute.

Other advantages are low cost of installation; high efficiency; easy handling of screenings; accessibility; simplicity; durability; self-cleansing, and small area required for installation.

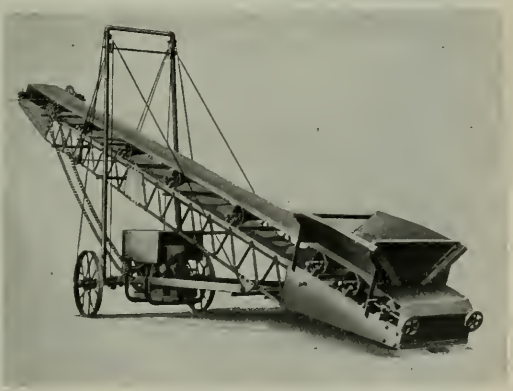


THE DORRCO SCREEN UNIT FOR SEWAGE.

RUSSELL PORTABLE 32-FOOT. CONVEYOR

The Russell Grader Mfg. Co. builds a lightweight steel constructed conveyor for loading sand, gravel or crushed rock directly into wagons or trucks. It has an endless 18-inch belt with a hopper attached to the lower end, that is suspended from a gallows frame mounted on wheels. The belt conveyor is driven by a sprocket chain operated by a 3 or 5-horse power gasoline engine under the conveyor.

The conveyor frame, 32 feet long and 26 inches wide, is adjustable through an angle of 30 degrees by a worm gear or crank. Its capacity for gravel or broken stone is 50 yards per hour and it weighs 3,100 pounds.

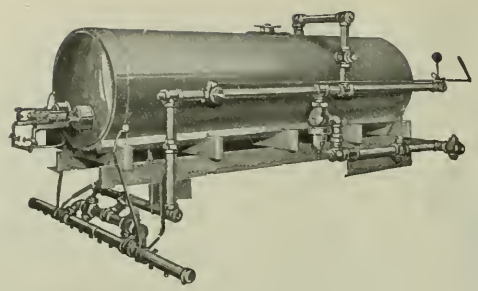


RUSSELL PORTABLE 32-FOOT CONVEYOR.

NATIONAL ROAD OILER

The National Road Oiler, manufactured by the National Steel Products Co., is designed to force heavy oils or asphaltic binders into the road surfaces under pressure, in the shortest possible time and with the least expenditure of labor and without loss of material. It consists of a tank and distributing mechanism that when not in service may be removed from the motor truck, leaving the latter available for other services and giving it all-the-year-round efficiency.

The rotary pump and the distribut-



NATIONAL ROAD OILER FOR PRESSURE APPLICATION.

ing nozzles are the two chief features of mechanical superiority. The pump, which is driven from the truck's transmission, has capacity of 100 gallons per minute against a pressure of 75 pounds per square inch, and it may be operated equally well when the truck is standing still or in motion. The maximum power required for it is 5 h. p. and the speed is 250 rpm.

The nozzles with three different size orifices are made of hard drawn brass and are of special construction that delivers the oil or other liquid in a fan shape spray with high pressure which develops extreme penetrating force. The elimination of adjustable outlets avoids the necessity of an operator at the rear of the machine to look after nozzle adjustments and prevents flooding the roadway with oil.

An air cushion and an automatic relief valve set at any required pressure between the distributing manifold and the pump keeps the pressure at the nozzle uniform regardless of the speed of the truck. The machine is made either with or without a heater in the tank and is constructed so as to agitate the material in the tank while it is being heated.

The tanks are made with capacities of from 500 to 1,250 gallons and can be installed on any truck chassis. They are made with welded joints and the larger sizes are provided with splash plates to prevent the surge of the contents. The pumps are of the positive displacement type providing for continuous flow and not requiring priming. They will lift liquids from a distance of 15 feet below the level of the pump. The special feature of the pump is that the buckets are hung on a rotor so as to ride on the cylinder walls with very light pressure. They take up wear automatically and at all times make perfect seat with the cylinder walls. The distributing manifold is divided in the middle into two sections controlled by valves accessible for cleaning through end caps.

The principal points of superiority claimed include quick and accurate control of all working parts; uniform heating; maximum width of road covered; elimination of wasteful distribution of materials; detachable from truck; accessibility; simplicity and economy of first cost and of operation.

INDUSTRIAL NOTES

The Pennsylvania Pump & Compressor Co. announces the opening of its Chicago office under the management of H. H. Montgomery.

The Chain Belt Co., Milwaukee, Wis., has announced the appointment of G. F. Sherratt as manager of the Pittsburgh office.

The Koehring Co. of Canada, Ltd., has been organized in Toronto to handle Koehring mixers, pavers, cranes and other construction and industrial plant equipment.

The Combustion Engineering Corporation, New York, announces the opening of a new branch office in the Guardian Building, Cleveland, which will be in charge of Frank Henderson.

Because of increasing activity in the power and railway divisions of the Pittsburgh office of the Westinghouse Electric & Mfg. Co., these two divisions have been separated. Barton Steveson, who has been manager of the two divisions, will continue as manager of the power division, and F. G. Hickling has been appointed manager of the railway division. S. R. Shave has been appointed manager of the price section of both the power and railway divisions in the Pittsburgh office.

The Federal Motor Truck Co. announces the establishment of a factory branch at San Francisco, with a completely equipped sales and service plant at 1123 Post street.

J. Ross Bates is to represent the Orton & Steinbrenner Co., of Chicago and Huntington, manufacturers of locomotive cranes, clam-shell and orange peel buckets and coal crushers, in the New England states and New York city. He has offices at 136 Liberty street, New York city, and 128 School street, Watertown, Mass.

A TRAIN OF TRAILERS ON HIGHWAY WORK

A fleet of 2½-ton, 4-wheel, reversible highway trailers, equipped with 2½-yard bottom dump spreader type bodies, is in use for maintenance and road construction by the Pinal County Highway Commission in Florence, Ariz. Ordinarily they are hauled by 2-ton motor trucks.

Occasionally, however, they are hauled in multiple by a 75 h.p. Holt tractor, which, in the accompanying illustration, is shown pulling a train of seven trailers, loaded at a central point with road resurfacing. This method secures the rapid delivery of large quantities of materials into long or short distances and over soft, hard or irregular ground without the delay and expense of installing an industrial track. The system is flexible and its units are always available for operation in different combinations and in different places without involving the necessity for permanent equipment or installation.

In a letter accompanying a photograph, from which the illustration was prepared, the highway engineer, W. W. Lane, stated that they have found the trailers entirely satisfactory in every way.

HOLT 75-H. P. TRACTOR HAULING TRAIN OF SEVEN 2½-TON HIGHWAY TRAILERS.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 May 13, 1922 No. 19

Birmingham's Water Works System

By N. M. Berberich* and W. A. Hardenbergh†

Water company mines its own coal—Maximum use of labor-saving appliances—Is increasing its pumping capacity forty per cent., adding eight filter units and extending its distribution system—Eighteen hundred consumers own nearly a million dollars of stock in the company.

Birmingham and its environs have grown so rapidly in population during the past twenty years that the problem of furnishing an adequate water supply has been a large one. In 1900 there were 4,500 consumers; in 1921, there were about 29,500, an increase of 600 per cent. The consumption of water is now in the neighborhood of twenty million gallons daily.

A complete program of improvements inaugurated

*Chemist, Birmingham Water Works Company.
†Health Officer, Jefferson County, Alabama.

GENERAL VIEW OF CAHABA RIVER PUMPING STATION, BIRMINGHAM

last year and now being carried forward to completion is the visible evidence of the policy of the Birmingham Water Works Company to keep its resources, supplies, and equipment ahead of the needs of the community. The program includes an increase of 40 per cent. in the pumping station capacity, already completed; the construction of eight new concrete filters, now under way; the construction of many thousand feet of additional water mains and lines; and the extension of the distribution system to two more of Birmingham's suburbs, Boyles and Tarrant City. During the past year, 1,918 meters were installed, which is about the annual average.

Water for the city is secured from two sources. Originally the supply came from Five Mile creek, which is located north of the city. In 1888, foreseeing the demand for a much greater quantity of water than could be secured from this source, the company developed a new supply at the Cahaba river, some ten miles southeast of the city. Today, Five Mille creek furnishes less than one-quarter of the city's water, as the amount available from this source totals only about five million gallons daily.

Five Mile Creek has a watershed area of 16 square miles above the waterworks' intake. The population density is 31.8 persons per square mile. There are no villages on the watershed, most of the inhabitants being farmers or dairymen. There appears to be no direct sewage pollution of this water, which is regularly of good quality for a surface supply.

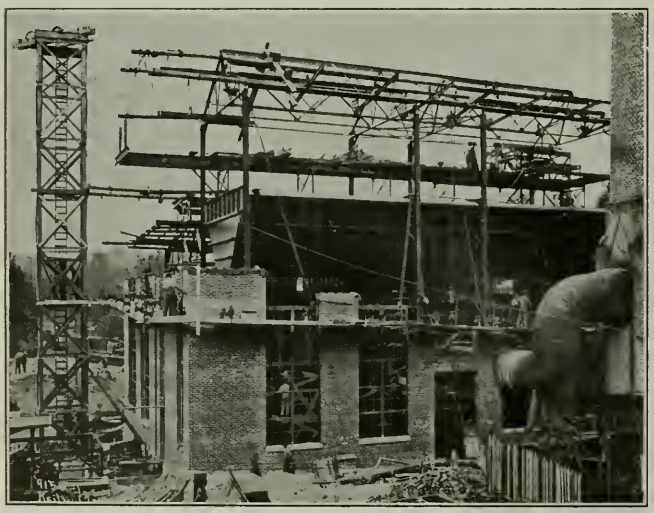
CAHABA RIVER SUPPLY

The Cahaba supply includes the Cahaba river and the Little Cahaba. The watershed of the former covers about 170 square miles, and of the latter about 30 square miles. Both of these streams are situated in a mountainous section of the county, sparsely settled. The population on the watersheds average about 20 persons per square mile. The company owns about 4,000 acres of land along these streams.

ENTRY TO WATER COMPANY'S MINE

At present as much water as is needed is taken from the Cahaba river, the flow of which, even in dry weather, has been sufficient to supply the needs of the city. To provide for the future, however, an impounding reservoir, Lake Purdy, has been constructed on the Little Cahaba, where is held sufficient water to supply the city for three months. The dam at Lake Purdy is of masonry, 40 feet high and 250 feet long, forming a lake of 350 acres with a capacity of more than a billion and a half gallons of water. The dam is so constructed as to allow it to be raised an additional 20 feet, which would increase the storage capacity of the lake to about 5,700,000,000 gallons.

When water from Lake Purdy is needed, it will be discharged from the reservoir and will flow down the Little Cahaba to the junction of that stream with the main river. Here a small diverting dam is so placed that the current in the larger river is reversed, and the water flows upstream in the Big Cahaba to the pumping station.



CAHABA PUMPING STATION UNDER CONSTRUCTION—JULY, 1921

The water taken from the Cahaba is pumped over the mountains to the filter plant on top of Shade's Mountain, six miles east of the city. In pumping from the Cahaba supply to the filter plant, the pumps work against a head of 458 feet.

CAHABA PUMPING STATION

The equipment at the Cahaba pumping station is modern and complete. An interesting feature is that the water works company owns and operates its own coal mine, taking from the mountains along the river all the coal it uses for pumping and for furnishing electric light to the pumping station and filter plant. In all, the company owns 440 acres of highgrade coal lands.

The coal mine, situated about a mile from the Cahaba pumping station, is entirely

VIEW SHOWING POWER HOUSE, CONCRETE ASH BIN AND COAL HANDLING EQUIPMENT. FROM THE TIME THE COAL IS DUG AT THE MINE ONE MILE FROM THIS PLANT UNTIL IT IS BURNED AND THE ASHES CONVEYED TO STORAGE BIN, ALL OPERATIONS ARE MECHANICAL. THIS NEW POWER HOUSE ALSO CONTAINS LARGE BUNKERS FOR COAL STORAGE.

electrified, and as much use of machinery as possible is made. The mined coal is not touched by hands from the time it leaves the mine until it is hauled away to the dump as ashes. A narrow gauge railway is used to transport the coal from the mine to the station, where it is automatically dumped into a crusher, whence it is carried by conveyors into a 250-ton coal bunker in the roof of the pumping station. From this bunker, it is fed by Taylor underfeed stokers to two new 509-horsepower Babcock and Wilcox boilers, just installed. Coal meters measure the amount of the coal used. The ashes are dropped into a pit, and then blown by steam conveyor into a concrete bin, from which they are dumped into cars and hauled away.

The water as it comes from the river passes through a coarse bar screen to exclude sticks, leaves and other floating material. Before reaching the pumps, it passes through a ¼-inch mesh traveling screen, operated by motor.

Latest equipment at the pumping station includes two new DeLaval steam turbines which have been installed in a large pump pit 40 feet deep and 54 feet in diameter. Each of these turbo-driven pumps has a capacity of ten million gallons per day. With its own coal supply, the company has found it much cheaper to operate steam turbines than to purchase the power and use electrically driven equipment. Three generators are in service at the pumping plant to manufacture such current as is needed for miscellaneous uses around the plant, for the coal mine, for the filter plant, and for the residences of the employees at the pumping station and the filter plant.

As a reserve in case of emergency, there are six 200-horsepower boilers and two vertical triple-expansion reciprocating pumps, each with a capacity of eight million gallons per day.

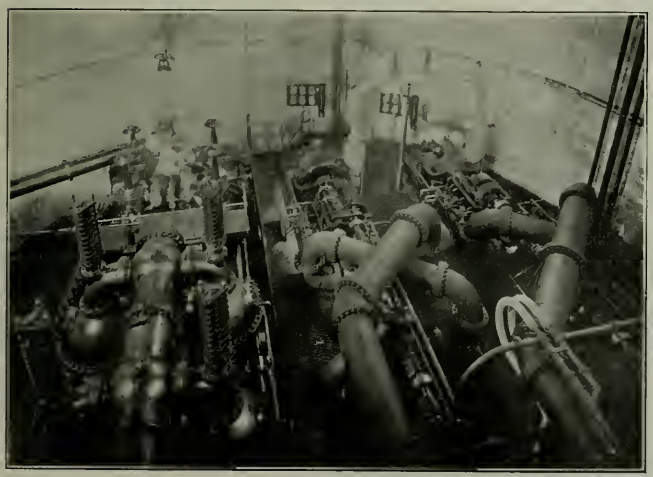
Inasmuch as the diversion dam on the Cahaba is far below the pumping station, some provision must be made for the disposal of the sewage from the half dozen houses used by the men operating the Cahaba pumping station. Disposal is accomplished by pumping the sewage over the mountain into the next watershed.

From the pumping station the water is carried in three pipe lines, two 20-inch and one 24-inch, to an equalizing stand-pipe, and thence through two 30-inch lines to the receiving basin of the Shade's Mountain filter plant, in all about three miles horizontally and 458 feet vertically.

FILTER PLANT

The receiving basin at the filter plant has a capacity of 125 million gallons. The settling basin just below has a capacity just in excess of thirty million gallons. In the year 1921 the average turbidity of the raw water was 300, which was reduced by storage in the receiving basin to about 75. In the passage from the receiving basin to the settling basin the water is treated with 8.5 to 17 parts per million of alum, resulting in a further reduction in turbidity to 25. The reduction in bacteria by storage and coagulation varies from 60 per cent. to 75 per cent., as shown in the accompanying table.

At the present time the filtering equipment consists of 38 iron tub filters, each having a capacity of 500,000 gallons a day. There are under construction at this plant eight new concrete filters, each with a capacity of one million gallons a day. The new filters will be similar in design to the old ones, with a perforated metal false bottom, eight inches of gravel, and 30 inches of sand.



LOOKING DOWN INTO PUMP PIT AT CAHABA, SHOWING TWO OF THE NEW DE LAVAL STEAM TURBINES.

Analyses of Water at Plants and at City Taps
Averages for 1921

Cahaba R. Water	Turbidity	Color	Bacteria per c.c.	P. C. of Time gas was found*
Raw	300	97	1060	60
Settled	25	..	415	..
Filtered	0	2	4	8
Effluent	0	2	2	0
Five Mile Creek				
Raw	128	32	1350	75
Settled	20	..	95	..
Filtered	0	2	5	5
Effluent	0	2	2	0
Sampling Points in City				
No. 1	0	2	3	0
No. 2	0	2	2	0
No. 3	0	2	4	0
No. 4	0	2	3	0

*1.0 c.c. Sample on raw water.
10.0 c.c. Sample on filtered and effluent water.

The analysis of the water showed the following averages for 1921:

	Parts per Million
Total Dissolved Solids	107.1
SiO_2	19.2
Fe	0.6
Ca	21.4
Mg	4.01
Nat. K	8.4
HCo_3	83.0
So_4	11.4
Co_3	0.0
Cl	2.4
No_3	0.8

The bacterial removal of the filters has been very good. Only rarely are 10 bacteria found per c. c. of filtered water, the average being about 5 per c. c.

The filtered water is collected in a clear-water basin 18 feet deep, having a capacity of three million gallons. So clear is the water after filtration, that the bottom of the clear-water basin can be seen distinctly.

A venturi meter a short distance from the clear-water basin registers the amount of water passed. Venturi meters are installed at the pumping station, also.

Just after passing through the venturi meter, the water is sterilized by means of a Wallace & Tiernan automatic chlorinator. The chlorine is applied at an average rate of 0.2 part per million.

FIVE MILE CREEK SUPPLY

The Five Mile creek supply is brought into the city by gravity, part of the way through an open canal and part of the way through a 30-inch pipe line. This water is treated at the North Birmingham plant, where are installed ten tub filters similar to those at the Shade's Mountain plant. Pumping is necessary from the settling basin to the filters, which is accomplished by means of two five-millon gallon centrifugal pumps driven by direct connected Lawrence engines. The chemical treatment at the North Birmingham plant is the same as at the Shade's Mountain plant. After filtration, the water is pumped into the mains.

DISTRIBUTION SYSTEM

From the Shade's Mountain filter plant, the water is brought to the city by gravity, passing through Red Mountain by means of a tunnel 1,100 feet long and 12 feet in diameter. There are two main pipe lines all the way from the filter plant to the city, with a supplementary line part of the distance.

One of the finest residence districts in Birmingham is located on the higher slopes of Red Mountain, far above the city. To give this section an adequate supply of water at a satisfactory pressure the company maintains the Rosedale high service station, and a separate distributing system. At this station, two Janesville pumps take water from the main leading into the city and force it into a standpipe high on the top of Red Mountain.

FINANCES

The rapid and continuous program of expansion which the Birmingham Water Works Company, a privately owned corporation, has been forced to carry through in order to keep ahead of the needs of the community has required the expenditure of large amounts of money. The company has financed improvements by the sale of its preferred stock to its consumers. Last year a half million dollars of cumulative first preferred stock was sold with which to make these improvements. This stock pays a dividend rate of 8 per cent. and is sold at par.

In order to facilitate the purchase of this stock and in order to insure a wide distribution, consumers who could not afford to purchase the stock for cash were given the opportunity of buying on the "Twenty Payment Plan," $5 down and $5 a month. During this time, the purchaser is paid 8 per cent. on his money. This plan met with success and the entire issue was disposed of within a short time. About eighteen hundred consumers own stock in the company.

During the coming year the improvements planned will require a total expenditure of approximately $400,000, which improvements have been approved by the Alabama Public Service Commission; and an additional issue of stock is now being sold to make these improvements on the same plan as the first issue was sold.

Wherever possible it has been the practice to purchase "Made-in-Birmingham" goods. The cast iron pipe is made at home as are the structural steel, brick, tile, cement, meter boxes and other equipment.

Cement-Lined Pipe in Danvers

The municipal water works system of Danvers, Mass., on January 1, 1922, contained more than 20 miles of cement-lined pipe from 12-inch to 4-inch diameter and nearly nine miles of 2-inch to 1-inch, and 32 miles of castiron pipe 20-inch to 4-inch diameter.

Cement-lined pipe is being removed as rapidly as possible, 16.32 miles having been taken up between 1906 and the end of 1921. This is because of the bursts and leaks continually occurring in this kind of pipe. Says Henry Newhall, superintendent of the plant, in his report for 1921: "The number of bursts and leaks on street pipes do not seem to diminish in spite of our renewals with castiron pipe. This would seem to show a universal weakness of all the old cement-lined pipe. We cut out a number by our renewals this year, but too late in the season."

There were 45 breaks and leaks in the mains in

1921. In spite of this, Mr. Newhall reports that a pitometer test of the system last year revealed no leaks in the street mains, indicating, apparently, that leaks are discovered and remedied as soon as they occur.

Repairing Chicago Waterworks Crib

Concrete deck and facing put on rock filled crib anchored to four-mile (intake pier) crib to make landing platform.

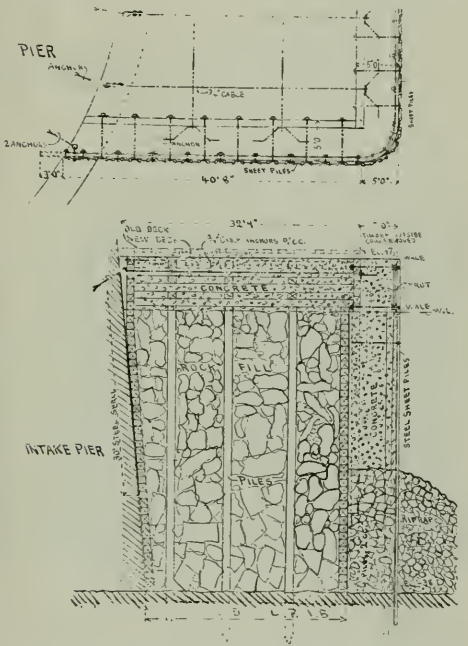
The four-mile crib of the Chicago Water Works Department is a steel shell concrete pier 114 feet in diameter, in water 38 feet deep and extending below the bed of the lake, to provide an intake shaft and connection with the supply tunnel to the city water works pumping station. As a lighthouse and an operating station are maintained on the crib, it is provided with a landing platform which, being exposed to the high waves, needs great mass and strength to resist injury.

It originally consisted of a large rock-filled wooden crib resting on the lake bottom and supporting a trapezoidal timber deck about 40x54x61 feet on the three outer sides and the fourth side formed by a segment of the circumference of the pier. This structure was reinforced with concrete and steel sheet piling.

Operations were commenced by removing the sheeting on the outside of the piles and cribbing, removing the deck and drilling eleven 1 1/2-inch equidistant horizontal radial holes in the pier concrete 5 feet above water level on the concave side of the platform. There were inserted in the holes 1 1/4-inch expansion bolts 4 feet long, with eyes that received the loop ends of 1 3/4-inch wire rope cables which passed through the crib and engaged washer plates and long bent anchor bars on the outer faces of the timber. The cables were tightly adjusted to hold the crib firmly in position against the pier.

A continuous wall of 14x3/8-inch Lackawanna steel sheet piles 50 feet long and weighing 41 pounds per linear foot were driven parallel to the three outer sides of the crib and five feet distant from it, except at the corners, which were curved to a long radius. The piles were driven against the outer face of a frame made of two horizontal wales, 5½ feet apart and separated by 5-inch vertical struts riveted to them. The top and bottom wales were each made with a pair of 8-inch horizontal web channels 3 inches apart, back to back, providing clearance for a one-inch horizontal tie rod which passed between them and engaged the crib timbers. The lower wale was supported on the top of a row of round piles about 9 feet apart on centers. The sheet piles took bearing against the outer faces of the wales and at the ends of the line the lower ends of five-pile units were bevelled to fit the batter of the pier masonry. The space between the sheet piles and pier was filled with concrete bags placed by a diver, thus sealing the cofferdam formed around the crib by the sheet piles.

The surface of the rip rap enclosing the cofferdam was levelled and concrete was deposited on it and carried up to water level, filling the space between the sheet piles and the timber crib and enclosing the



PLAN AND SECTION OF REPAIRED PIER.

DRIVING SHEET PILES IN COFFERDAMS AROUND OLD CRIB.

two tiers of anchor rods projecting from the sheet piles. A continuous mass of concrete was deposited on top of the timber crib and rock fill, enclosing the timbers to an elevation of 9 1/2 feet above water level, above which the old timbers were removed and the concrete formed a continuous deck over the old crib and the coffer-dam, holding and protecting all of the ties, cables, wales and struts.

The work was executed by the Bureau of Engineering, Department of Public Works of Chicago under the direction of Myron B. Reynolds, Engineer of Water Works' design.

Decatur's New Water Works Dam

By E. E. Pierson

A two-million dollar dam, financed largely by popular subscription to stock, relieves the city of frequently recurring water shortage. Concrete dam built by use of a steel form in one unit, carried by a traveler.

Decatur, Illinois, is now safe from water famine, for this spring's rains have filled to overflowing its new eight billion gallon reservoir, construction of which began in July, 1920.

The Sangamon river, from which the city draws its supply, is a small stream that runs nearly dry in the summer months, and when the city's population increased by more than 25,000 a few years ago, annual water shortages seemed certain unless radical action were taken at once to increase the dry-weather supply. Some of the leading industries of the city threatened to withdraw their plants if this condition continued.

FINANCING THE IMPROVEMENT

By impounding the spring freshets the problem could be solved, but the estimated cost of this was two million dollars, and the city was within half a million of its debt limit. Public meetings were held and popular interest and concern aroused, and, under the leadership of the Association of Commerce, a water supply corporation was formed to finance the project. Within four days after the books had been opened 981 citizens had subscribed for more than the needed amount of stock, and the entire amount has been paid in.

By action of the city council the water rates were doubled, the new figure being twenty-five cents per thousand gallons, yielding $135,000 in annual revenue. This money pays the interest and a portion of the principal each year and in twenty years the entire debt will be paid and no one will feel the burden. The stock pays 7 per cent. interest.

The new corporation, headed by Wilson Bering, former postmaster, bought 4,200 acres of land which would be flooded by the impounded water of the proposed reservoir, paying for it $612,000, ranging from $65 to $200 per acre. Where the owner would not sell for a reasonable figure, condemnation suits, twenty-two in all, were filed. As soon as title had been acquired to the land, the houses and timber were removed at a cost of $100,000 more. The timber felled was given away for firewood.

The original water supply dam raised the water to 595 feet above sea level. The new dam has raised it seventeen feet higher to elevation 612. For the sake of safety and to provide for the future, the 615 contour was taken as the high water mark and everything within this was acquired, including portions of more than sixty productive farms and whole groves of timber. The Sangamon valley and feeding streams had to be prepared for flooding and where public property such as roads and bridges would be inundated by the water of the reservoir, these were raised or relocated. The bridges were raised fifteen feet above the surface of the lake. The cost of changing bridges and approaches and constructing new roads reached $500,000 more.

CONCRETE WEIR SECTION OF DAM, OVERFLOWING FROM RAINS A FEW WEEKS AFTER COMPLETION.

THE PROJECT DESCRIBED

The project, now practically completed, was to construct across the Sangamon river a dam, eleven hundred feet of which was of earth with a concrete core and 550 feet was a concrete spillway thirty feet high. This dams the river back for thirteen miles and gives an average width of half a mile to the reservoir.

In addition to the unlimted supply of water, boating and fishing is provided. Beautiful driveways are being laid out along the shores of the picturesque lake. Shore land is being purchased for summer cottages, camps and clubs, some choice tracts being held by owners as high as $2,000 per acre. Many handsome residences will be built. The city park system has been extended and much of the land acquired by the water company will be utilized for park purposes, 2,600 acres in all being added to the present tracts, including miles of beautiful wooded bluffs, fringing a reservoir lake.

The engineers of the dam were Pearce, Greeley & Hansen of Chicago. J. Abbott Holmes was resident engineer in charge of the work. The contract was let to C. M. Cope of Decatur and J. J. McCabe was superintendent.

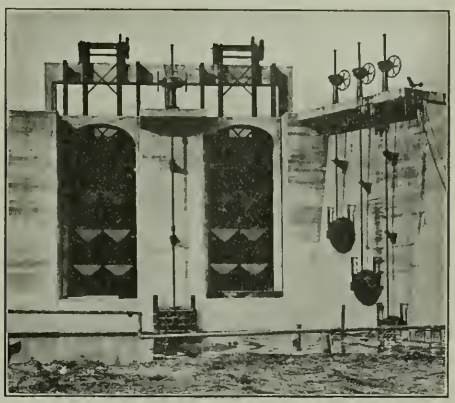
For a foundation of the concrete or weir portion of the dam 46,000 lineal feet of bearing piles were driven. The concrete work was divided into three stages. First the apron below the dam was placed, in alternate sections. Then there was built, supported by the piles, a foundation course six feet thick and thirty feet wide, extending two feet beyond the upstream face of the dam, this also being built in alternate sections. Two longitudinal tongues of concrete were built on the top surface and a channel near the down-stream toe to key it to the structure above. The foundation course was built in a cofferdam constructed by means of steel sheet piling.

The body of the dam rises 22½ feet above the foundation course and is 470 feet long. It was constructed in 18-foot sections, each requiring 250 cubic yards of concrete. In constructiong this, a steel form was used which was suspended from and braced in exact position against a timber traveler. This form was twenty feet long and was built up of angles and plates. Each plate had a hole and cover piece permitting tie rods to be placed in any desired number and position, the tie rods passing through waling timbers on the outside of the form. A wooden bulkhead was placed at the advance end and held in place by one-inch tie rods which extended the full length of the section and were screwed into malleable iron sleeves attached to corresponding rods in the section already constructed. These sleeves were placed just inside the bulkhead so that the short piece of rod extending through the bulkhead could be unscrewed when the bulkhead was to be removed. Similar sleeves were used on the one-inch transverse tie rods just inside the form, and when the form had been released by unscrewing the short rods, the shallow holes were filled with cement mortar.

The bulkhead was so formed as to leave in the vertical joint face vertical recesses 6 by 30 inches to key the sections together. Two recesses were formed in the top of the spillway to permit the hinged steel frames of the flashboard to be lowered during high water.

The traveler that carried the steel form was thirty feet high and thirty-two feet wide. Each side sill was carried by four 9-inch double-flanged wheels that rode upon a rail spiked to timber stringers laid upon the concrete base course. Suspension rods and brace rods, with adjusting ratchets, held the form in position, the concrete toe being secured also by a waling timber, fitted to bolts embedded in the concrete base. The steel form was designed by the Blaw-Knox Company. The concrete was transported upon a trestle erected across the river parallel and close to the dam.

The engineering problems were not complicated and the construction proceeded smoothly after once getting under way. Heavy rains filled the reservoir to its capacity soon after it was completed and water has been pouring over the spillway the greater portion of the spring. Even should not a drop of rain fall for two years, the city of Decatur will have enough water for all possible needs during that period.



GATES AT END OF WEIR SECTION.

LOCATION OF GATES, AT JUNCTION OF EMBANKMENT AND WEIR SECTION.

Water Bond Campaign by Engineers

By R. E. McDonnell

After the failure in 1921 of the $11,000,000 water bond project for Kansas City, the Engineers' Club of Kansas City conceived the plan of conducting an educational campaign in a further effort to carry the bonds, which were urgently needed for a new filtration works, two pumping stations, larger feeder mains, reservoirs and other work. The president of the Engineers' Club, Alexander Maitland, Jr., is also chairman of the new Water Commission. This bi-partisan commission of four men were elected in

1921 to handle the entire new construction and also to operate the present works, thereby removing it from political control. As many engineering questions were involved, it was thought proper to have the Engineers' Club present engineering facts, figures, costs and other data before the 170 civic organizations so that the public could intelligently vote on the project.

Mr. Maitland appointed a water committee of eleven engineers, with R. E. McDonnell, consulting engineer, as chairman. This committee arranged its sub-committees on: Statistics, Filtration, Fire Protection, Typhoid, Present Works, Ozark Supply, Missouri River Supply, Publicity, Speakers, etc., and proceeded to collect and assemble diagrams, data, stereopticon slides, newspaper articles and other information for use before civic and community meetings.

Preliminary to the campaign, a successful effort was made to eliminate all other bond projects, for at the former election defeat was due in a large measure to having eighteen other bond projects up for voting along with the water works. A city campaign was in progress and before political platforms were made public, the leaders of each party were induced to insert a plank favorable to the water works.

After nomination the candidates were pledged to support the bond project.

Prizes were given for water bond slogans; some presented were: "Water the Town and Watch it Grow," "Millions for Water Means Water for a Million," "H_2O, Let's Go." These were put in windows and upon windshields of automobiles. The Engineers' Club discovered that its membership contained many speakers of ability and illustrated talks were given before about sixty of the larger civic organizations. The campaign was also conducted through the schools by talks, first before all the teachers of the city, then before high schools and civics classes. Several thousand high school and grade schools students themselves made four-minute talks upon the water works' needs at classes and before their parents at their homes.

A feature of the proposed improvements was filtration, and the typhoid rates of cities with filtered water were compared with that of Kansas City, which was found to be the largest city in the United States using river water without filtration. Diagrams and statistics were circulated at meetings, showing the health improvement in other cities after filtration.

The partial water softening proposed in the new plant was a campaign hit and was made effective by the speakers giving soap demonstrations with soft water and with the hard water. It was shown that the saving in soap alone would pay the entire bond interest. Demonstrations before audiences of women were both convincing and effective by showing the results of using hard water and then soft water, in washing linens, laces, lingerie, etc.

Records were secured of the people voting at the 1921 election and it was found that only from 7 to 8 per cent. of the membership of civic organizations voted at all. The voting record of each civic club at the previous election was publicly presented, much to their embarrassment and humiliation, for it was found the clubs were strong on civic duty but sadly delinquent when it came to voting. This feature of the campaign was effective in getting out a large vote.

The results of the campaign showed a vote of over 40,000 majority and as a direct result it was found that in one ward where the water works' subject was especially well covered, the vote was 8 to 1 for, while in wards without talks, a bare majority vote was secured.

One beneficial result to the Engineers' Club was the bringing of the engineers prominently before the public in a worthy civic duty performed in behalf of their city.

Springfield Water Works Maintenance

In his report for the year 1922, Alfred E. Martin, superintendent of the Springfield, Mass., water works, mentions several interesting items connected with the maintenance of the system.

He states, for instance, that the pipe trenching machine owned by the department "still continues to prove its usefulness and value. With it we have been enabled to keep our pipe laying gang reduced to its very lowest terms and yet keep our extension and pipe-laying work up-to-date, and twice as much work or even more could be performed if occasion required. It has never yet been worked to its limit." During the past season the department laid eight miles of mains.

The department had so successfully used an electric pipe thawing machine that a second machine of this kind was secured and was ready for service in December, 1920, but since then up to January, 1922, it had not been necessary to use either of them, as no service pipes were frozen.

"This is the first full year of the use of our pipe cleaning instrument, and it has proved to be a very popular as well as money-saving appliance. The average cost of cleaning a 50-foot service is between $3 and $5, and it saves anywhere from $40 to $80 each time it is successfully used ,and I have yet to hear of a failure. If the pipe is straight, there is absolutely no trouble, but if it changes its direction, the pipe sometimes must be uncovered at the bend, as the tool will not work in a crooked pipe. Very few such services are found, however, and we have cleaned not less than 500 during the year, at an approximate saving to the owners of $25,000, besides saving the cost of opening and repairing many paved streets."

On November of last year a 36-inch main broke at a point along a country road near Ludlow reservoir. The crack extended the length of one pipe on its lower side. It was repaired by turning the pipe so as to bring the crack on top and acetylene welding it. This was the first and only job of its kind done in this system.

Electrolysis caused two serious impairments to the service during the year. One was in a cast iron pipe and the other in a 42-inch steel main. In the latter case a hole had been eaten through the steel plate due to the breaking of the insulation provided to protect the pipe, thus permitting a flow of electricity to a 6-inch service pipe which crossed directly over the steel pipe.

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The Water Consumers Be Pleased

In a public meeting recently held by a New Jersey town to discuss the question of a new water supply, one of the citizens stated that, although the chemists and other technical experts assured him that the water, after being filtered and disinfected, was perfectly safe, still he objected to drinking water in which he knew sewage had been discharged, thousands made a practice of bathing in summer, and occasionally dead animals were thrown. The early history of the supply was so disgusting to him that he was unwilling to use it as a beverage.

Another case at point is reported from Decatur, Ill. That city is discussing sewerage for the southeastern section of the city and among the points to be decided is whether the storm water containing the washings from the streets and yards will be discharged above the dam which impounds the water for the city's water supply, or will be carried at greater expense to an outlet below the dam. An editorial in one of the local papers remarks: "It seems to be a part of the old question as to whether the community wishes to tolerate a condition of things which, while not a menace to health, look bad and disturb people with squeamish stomachs."

A generation ago the majority of American cities were drinking diluted sewage and very little was said or thought about it except by sanitarians. Due to the activity of these, and especially of health boards, the entire country has been educated to consider carefully the water which they drink, and the result is shown in the greatly reduced typhoid rates. Having had their attention turned to the subject, however, citizens generally are not stopping at the consideration of safety alone, but are demanding that the water supplied to them shall have passed through no conditions or experiences that tend to excite repugnance or loathing.

Where it is possible to obtain water so acceptable historically as well as chemically and bacteriologically and the people are willing to pay for it, being fully informed as to what the cost will be, there would seem to be no reason why water works officials should not provide them with what they want. In the case of Decatur, for instance, apparently the citizens are to be informed of the additional cost of keeping the street drainage out of their water supply and an opportunity given them to decide whether they desire to pay it.

There are many instances where it is impossible for a community to obtain water which has never been polluted, and in those cases the consumers must be content with such purification and rejuvenation as science is able to furnish.

However, the attitude of some engineers and chemists, that because water is safe the consumers are foolish to object to it merely because of past contamination and should be opposed in their efforts to obtain uncontaminated water, is not in our opinion a proper one. The feeling of dislike which the consumers have for some water supplies is by no means unreasonable, and if they wish to pay the cost of a more acceptable supply, the officials should do everything in their power to meet their wishes in the matter.

Financing Water Works

The raising of funds for extensions and improvements to two water works systems, one a municipal and the other a private, which is described in this issue, offers suggestions that may well be of service to many other cities. In the case of the private plant, nearly a million dollars of 8 per cent. cumulative first preferred stock of the company was sold to the consumers at par on easy terms, about eighteen hundred (six per cent. of the consumers) having become holders of this stock. Besides the raising of needed funds, this is calculated to lessen the feeling of criticism or even animosity that frequently is felt by consumers toward a privately owned plant.

The other article describes how a number of citizens who were engineers carried on a campaign of education to give their fellow citizens the benefit of expert and unbiased knowledge on the subject of a proposed water works reconstruction project, with the result that the bond issue for carrying it out was approved, although a few months previous it had been voted down. This points out one way in which engineers can render important service as citizens.

Decreasing Typhoid Mortality

Figures just published by the U. S. Public Health Service, derived from those of the Census Bureau, show a remarkable reduction in typhoid death rates during the years 1916 to 1920, especially when the low rate already reached by the former year be considered.

The amount of typhoid fever in a community is recognized as one of the best indexes of its healthfulness. So, also, the mortality rate from this cause is a very important sanitary index.

The steadily decreasing mortality rate from typhoid fever is therefore most gratifying. The decrease in the registration States of 1916 was from 13.3 per 100,000 population in 1916 to 7 in 1920. Of the States in the registration area in 1920, Massachusetts and Wisconsin share the honor of having the lowest rate (2.5), while the highest (22.4) appears for South Carolina. Of the 11 States showing rates by color, the lowest rate for the white population was 3.6, and the lowest for the colored was 4.6, both for New York State; whereas the highest rate for the white population was 19.1 for Kentucky, and the

Deaths and Death Rates from Typhoid Fever in the Registration Area (Exclusive of Hawaii) and the Registration States, 1916-1920

Area.	Number of deaths			Rates per 100,000 population				
	1920	1919	1918	1920	1919	1918	1917	1916
Registration area[1]	6,805	7,860	10,210	7.8	9.2	12.6	13.5	13.3
Registration States[2] (1916)	4,890	5,588	7,722	7.0	8.1	11.3	12.5	13.3
California	166	182	196	4.8	5.4	6.0	6.9	6.9
Colorado	87	79	141	9.2	8.5	15.4	10.3	13.2
Connecticut	57	55	72	4.1	4.0	5.4	9.0	7.2
Delaware	25	39	[3]	11.2	17.6	[3]	[3]	[3]
Florida (total)	143	175	[3]	14.6	18.3	[3]	[3]	[3]
White	86	111	.....	13.3	17.7	...	...	...
Colored	57	64	.....	17.2	19.4	...	...	...
Illinois	380	383	519	5.8	5.9	8.2	[3]	[3]
Indiana	284	332	400	9.7	11.4	13.8	17.2	21.2
Kansas	141	129	292	8.0	7.3	16.6	18.8	14.9
Kentucky (total)	490	648	651	20.2	26.9	27.2	35.1	31.1
White	419	536	540	19.1	24.7	25.0	31.6	29.1
Colored	71	112	111	30.2	47.2	46.2	65.9	48.1
Louisiana (total)	280	408	709	15.5	22.8	39.9	[3]	[3]
White	129	221	380	11.7	20.3	35.4	...	...
Colored	151	187	329	21.5	26.6	46.7	...	...
Maine	69	44	59	9.0	5.7	7.7	10.8	11.3
Maryland (total)	100	170	242	6.9	11.8	17.0	18.2	19.0
White	68	112	157	5.6	9.4	13.3	15.8	16.1
Colored	32	58	85	13.0	23.7	35.0	29.4	32.8
Massachusetts	95	105	153	2.5	2.7	4.1	4.9	4.7
Michigan	294	275	334	7.9	7.6	9.4	11.3	12.8
Minnesota	71	79	87	3.0	3.3	3.7	4.3	5.5
Mississippi (total)	333	364	[3]	18.6	20.3	[3]	[3]	[3]
White	99	130	...	11.5	15.3	...	...	...
Colored	234	234	...	25.1	24.9	...	...	...
Missouri	341	426	665	10.0	12.5	19.6	20.8	19.5
Montana	27	39	53	4.8	7.2	10.1	15.7	10.9
Nebraska	58	[3]	[3]	4.5	[3]	[3]	[3]	[3]
New Hampshire	30	15	20	6.8	3.4	4.5	6.1	5.0
New Jersey	105	100	167	3.3	3.2	5.5	6.7	7.1
New York (total)	379	374	585	3.6	3.6	5.7	5.9	6.2
White	369	367	571	3.6	3.6	5.7	5.8	6.2
Colored	10	7	14	4.6	3.3	6.9	7.6	6.3
North Carolina (total)	322	444	570	12.5	17.5	22.8	29.5	28.9
White	167	255	307	9.3	14.4	17.6	23.0	22.1
Colored	155	189	263	19.9	24.5	34.4	44.2	44.0
Ohio	435	457	762	7.5	8.0	13.6	12.6	14.2
Oregon	39	38	73	4.9	4.9	9.5	[3]	[3]
Pennsylvania (total)	503	612	934	5.7	7.1	10.9	10.7	13.9
White	464	574	884	5.5	6.8	10.7	10.4	13.7
Colored	39	38	50	13.4	13.4	18.3	17.8	19.2
Rhode Island	17	20	34	2.8	3.3	5.7	5.8	7.2
South Carolina (total)	379	440	588	22.4	26.3	35.5	31.9	34.2
White	131	130	207	15.9	116.0	26.0	22.6	27.6
Colored	248	310	381	28.6	35.9	44.3	40.3	40.1
Tennessee (total)	434	653	699	18.5	28.0	30.2	38.3	[3]
White	311	462	499	16.4	24.6	26.8	35.1	...
Colored	123	191	200	27.3	42.2	43.9	51.4	...
Utah	31	42	41	6.8	9.4	9.4	13.7	10.7
Vermont	37	11	30	10.5	3.1	8.5	7.1	6.5
Virginia (total)	260	357	407	11.2	15.5	17.9	20.8	24.8
White	157	210	249	9.6	13.1	15.7	15.2	20.6
Colored	103	147	158	14.9	21.3	23.0	33.4	34.2
Washington	76	57	98	5.6	4.2	7.4	9.4	6.2
Wisconsin	65	80	97	2.5	3.1	3.8	5.2	7.9

[1] For the years indicated at top of columns.
[2] Figures in each column reading across are for the States in the registration area in 1916, including the District of Columbia.
[3] Not admitted to registration area until a later date.

highest for the colored was 30.2 for the same State.

Of the 33 States shown for 1919 and 1920 in the accompanying table, only 9 show higher rates in 1920 than in 1919. These States with their rates for 1919 and 1920, are as follows:

State	1920	1919
Colorado	9.2	8.5
Connecticut	4.1	4.0
Kansas	8.0	7.3
Maine	9.0	5.7
Michigan	7.9	7.6
New Hampshire	6.8	3.4
New Jersey	3.3	3.2
Vermont	10.5	3.1
Washington	5.6	4.2

An even more remarkable decline in typhoid rates is reported by the Industrial Department of the Metropolitan Life Insurance Company, based upon the records of approximately 13,500,000 insured persons. Although the total death rate from all causes increased from 966 in February, 1921, to 1,011 in February, 1922, the typhoid rate decreased from 4.0 to 1.9, or more than 50 per cent. A few others showed considerable decrease, especially measles and whooping cough, but no others except these two even approximate the record of typhoid fever.

These figures certainly seem to indicate that those responsible for our water works are to be congratulated upon the good work they are doing. They also show that, so long as eleven states have a rate above 10 per hundred thousand, while thirteen have a rate below 5, there is still abundant room for pronounced improvement in many of the states.

Engineers' Plans for State Health Boards*

Regulations of the State Boards of Colorado, Connecticut and Florida and Delaware, with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits.

Colorado. Plans not required by law, but generally submitted, and frequently revised in accordance with suggestion of Board of Health.

Connecticut. Plans for *sewerage* should include map showing topography and location of existing sewers and outlets; map showing location of proposed sewers, outlets, manholes, and other accessories; profiles of proposed sewer showing sizes, grades, sections and materials of construction; details of appurtenances; plans for the proposed sewage treatment works, including map of property to be used and detailed plans of proposed works.

For *water works* the plans should include map of municipality; detailed plans of methods of obtaining, pumping, purifying, otherwise treating, storing and distributing the supply; a water shed map showing reservoir development; or if supply is of underground source, map showing topography, water courses, sewers, drains, dwellings, roadways, barns, privy vaults, cesspools and all other sorts of contamination within 1,000 ft. of the proposed source of supply; also details of geological formations giving water bearing strata from which the supply is drawn; and an explanation of the basis of the design and the selection of the proposed source. Also there should be filed with the application complete detailed plans and specifications, report of engineer, and copy of council or town meeting action.

Maps and plans shall be on white paper or black cloth prints. Scale of general plans shall be not less than 300 feet to one inch. Suggested outside dimensions are 22x30 (to be used as standard so far as possible), 11x8½, 25x38 and 22x70 (profiles only). Title, date and signatures shall be in the lower right hand corner.

Blanks are provided for making engineer's reports. These call for quite detailed information. The more important items are as follows:

Water Supply:

Population: Last census, served immediately and designed to serve. Industries. Causes for building system. Is there sewerage?

Quantity: Capacity, gals. per 24 hours; how long before consumption will equal this? Provision for future extensions. Quantity needed immediately for domestic, for industrial and for public purposes.

Source: Surface supply: Name of stream or lake; location with respect to municipality; area of watershed above intake or dam, topography, geology, population on watershed. Principal sources of pollution, sewage and industrial, within 20 miles above intake. Proposed protection of supply (removal of pollution, patrol, purchase, etc.).

Source. Ground water: Location and area of land controlled. Number of inhabitants within 300 feet, 500 feet, 1,000 feet; number and kind of privies within 500 feet. Other sources of possible contamination. Topography of site and surrounding territory.

Wells: Number, kind, size, depth, maximum and minimum distance between. Material, size and depth of casing. Material, type and length of strainer. Kind and thickness of each formation penetrated by well (note water-bearing strata). Distance to nearby body of water and elevation relative to water in wells. Normal yield, if flowing well.

Springs: Number; formation from which each issues; normal yield; distance to nearby body of water and relative elevation.

Rainfall and streamflow: Average yearly rainfall; min. for three driest consecutive months of dryest year. Runoff in sec.-ft., yearly average, max. monthly average, min. monthly average, average May to November; method of obtaining runoff measurements. All streamflow data available.

Reservoir. Impounding: Location of dam; type, materials of construction, length of crest and of spillway, height of crest and of spillway above stream. Elevation of high water and to which water may be lowered. Area of water surface at high and low water, and storage capacity between these; number of days' supply this represents. Average depth of reservoir when full. Area 5 feet or less deep. Preparation of bottom and sides.

Reservoirs, Storage: Location; how filled. Area, depth, capacity; capacity available. Preparation of bottom and sides.

Reservoirs, Distributing or Equalizing: Type and materials of construction (basin, standpipe, elevated tank). Will it be covered? Capacity. Av., max. and min. elevation of flow line above municipality.

Pumps and pumping: Connection of source of supply to pumps. Number, type and rated capacity of low-lift and service. Power used. Station pressure, static and dynamic. Size of discharge main. Provision for meas-

*Continued from page 323.

uring discharge. What records will be kept? Test of ground water supply—duration and rate of continuous pumping; lowering of water level; equipment used.

Treatment: Settling basins; number, capacity, settling period, continuous or fill and draw; disposal of sludge. Coagulation basins; number, capacity, retention period, disposal of sludge; chemicals used and method of handling and introducing them.

Rapid sand filtration: Number, shape, area, materials of construction. Depth, effective size and uniformity coefficient of filtering material. Nominal capacity. Method of washing (air or mechanical agitation, maximum washing head, rise in inches per minute; source of wash water; method of equalizing pressure). Rate controllers and loss-of-head and rate gauges.

Slow sand filtration: Same as above, but substitute "cleaning" for "washing."

Deferrization plant: Describe aeration; chemical treatment; sedimentation basin, capacity, retention period, sludge disposal; filters, number, area, depth and character of filtering material, rate of filtration, nominal capacity, method of washing.

Softening plant: Chemicals used and points of application; reaction period; velocity through reaction chamber. Sedimentation basins, number, capacity, retention period, sludge disposal. Filters, number, area depth and character of filtering material, rate of filtration.

Sterilization: Treatment used and points of application; preparation and application of chemicals; operation continuous or intermittent. Quantities of disinfectant to be used.

Treated water storage: Capacity, material of construction, retention period.

General: Provision for laboratory and analytical control of plant; for collecting samples of water; for conducting test of plant on completion. Will plant be operated continuously or intermittently? Arrangements for expert management. Any unusual features? Number and capacity of wash water pumps, air compressors. Low-lift pumping equipment.

Emergency Supply: If any, describe, with conditions under which it will be used. If used for fire protection by industrial establishment, describe connections.

Distribution: Length and material of each size of pipe. Number of dead ends. Minimum depth of earth covering. Distribution by direct, gravity or combined pressure? Will meters be installed on all services?

Sewerage:

Population:: Total, sewered district, immediately tributary, ultimate provided for, probability of future increase.

Area: Immediately and ultimately tributary.

Rainfall and runoff: Area to be drained, topography, character of soil, per cent. impervious, records of storms, per cent. runoff calculated from above, quantity used in design, how estimated.

Outlets: Construction, elevation relative to high and low water, distance to nearest community and nearest water supply intake; character of stream below outlet, tributary to and use of.

Industrial wastes: Names of industries and character and quantity of waste from each.

System; Combined: Number of manholes, lampholes, catch basins, street inlets; are manholes located at all changes in grade or direction, maximum and average distances between them; ventilating sewers; elevation of ground water, method of making joints in wet and in dry trenches; house connections, sizes, by whom built, will Y's be placed for future? Will cesspools be connected? Number of dead ends; method of flushing; method of trapping catch basins. Plans of storm water overflows, and amount of flow causing them to operate and how estimated.

System; Separate: Any storm, roof or cellar drain water or waste from water motors to enter sewer? Will cesspools be connected? Number of flush tanks and estimated amount of water from them. (Manholes, etc., as for combined system.) Method of ventilating. Ground water elevation. Joints in wet and in dry trenches. To what extent are sewers underdrained?

Size and material: Length and shape of each size.

Pumping: Location of plant, amount to be pumped, lift; type, make and capacity of pump; amount and kind of power. Pumping continuous or intermittent? Amount pumped to be measured?

Screens and screen chamber: Location, method of cleaning and disposal of screenings.

Grit chamber: Dimensions, average, maximum and minimum velocity, disposal of materials.

Treatment Works: Site; water receiving effluent and area and nature of water shed draining it, with area and average depth if lake or pond; average, maximum and minimum estimated flow in second-feet, total and per 1,000 population on watershed. Distance and direction of works from center of municipality and from nearest habitation, and number of habitations within 1,500 feet. Probable development of vicinity of works. Direction of prevailing winds. Area to be used—provision for future extensions. Elevation of high and low water at outlet; levees to protect against floods? Head available in works.

Tanks: Number and kind; daily flow for which designed; provision for measuring flow; number and capacity of units; capacity of sedimentation and of sludge compartments; retention period and nominal velocity; method and frequency of cleaning. Elevations of inlet, outlet, flow line and bottom of tanks, and of sludge beds. Methods of using chemicals, if used.

Dosing Chamber: Location with respect to filters; capacity; kind of dosing apparatus and method of housing it.

Trickling filters: Number, area, material of walls and floor; thickness and limits of size of each class of filtering material; method of underdraining; quantity of sewage designed for, nominal rate in gallons per acre per day; method of application and distribution (distributors, type and spacing of nozzles, head on nozzles, etc.). Number, capacity and depth of final sedimentation basins, elevation of flow line and bottom, and method of sludge disposal.

Contact filters: Practically the same as for trickling filters.

Intermittent filters: Practically the same as for trickling filters.

Disinfection: Kind of chemical and apparatus and method to be used.

Sludge treatment and disposal: Filters; area, material, depth, under-drainage, outlet, depth of flooding. Lagoons; length, width, depth, underdrainage, outlet. Presses, centrifugal machines or other dewatering apparatus. Final disposition of dried sludge, or of wet sludge if not dried.

Delaware. No state control.

Florida. Plans for voluntary observance under preparation similar to those of Ohio and other states.

Legal Snarls in Recent Contracts

Columbus, O., on April 20, received 12 bids for constructing the O'Shaughnessy dam, ranging from $1,001,616 to $1,548,690, the engineer's estimate having been $1,375,300. The contract was awarded to the lowest bidder, but he, claiming that he had made an error in his bid of about $73,000, refused to sign the contract, upon which the director of public service declared his $100,000 check forfeited to the city. The contractor entered suit to recover, the case being heard last week, and it is expected that the decision of the court will be handed down next week. Notice for new bids on May 25th.

Erie, Pa., last month received bids for a 30-inch storm sewer, specifying double-strength pipe. The lowest bid for this was that of the Penn-Erie Construction Company, but another contractor offered to construct the sewer of segment block for $181 less, and that bid was accepted. The Penn-Erie Company, maintaining that the city cannot legally accept a bid not in accordance with the specifications, has obtained a preliminary injunction preventing the awarding of contract to the bidder.

Filter Plant Control and Operation

Recommendations and suggestions by engineers of the Ohio State Health Department and of the filtration plants of a number of Ohio cities, concerning the operation of water filtration plants and the standardization of laboratory practice.

Ohio contains fifty-six water purification plants, serving thirty cities, nineteen towns and seven unincorporated communities. Representatives of forty-six of these last November organized the Ohio Conference on Water Purification. One of three topics discussed at the first conference was "Standardization of Filter Plant Control and Operation." A synopsis of the opinions and conclusions on this topic is given below, and, in view of the high standing of the members of the organization, they deserve careful consideration by, and should prove helpful to, all engineers and superintendents of water filtration plants.

PART I—LABORATORY PRACTICE

COLLECTION OF WATER SAMPLES

It was the consensus of opinion that all samples should be collected in properly sterilized glass bottles protected by metal containers, both of which were subjected to sterilization at the same time. In cases where the containers were sent out from the laboratory the practice would be to secure the stopper by the use of leadfoil or manila paper in addition to the metal container in which the bottle is placed. All samples should be analyzed as promptly as possible. The frequency with which tests shall be made was decided upon as daily for plants having superintendents actively in charge and three times weekly for small plants being supervised.

STANDARD METHODS OF ANALYSES

For convenience these items will be classified first as to bacterial data, and second as to physical and chemical data.

It is important that every filter plant superintendent should own and have available at his plant a copy of the latest edition of The American Public Health Association "Standard Methods of Water Analysis." It was agreed that the above-mentioned work should be the standard for all laboratory work performed by members of this conference. Changes in laboratory practice to conform to the above plan will take effect January 1, 1922. It was recommended that the American Public Health Association and the American Water Works Association reach an agreement as to standard methods of water analysis.

1. *Fermentation Tests.* Lactose broth should be the medium in preference to lactose bile.

It is believed that Dunham tubes are more convenient for the fermentation test.

Fermentation tests should be read at the end of 24 hours and at the end of 48 hours. If 10 per cent or more of gas is noted at the end of 24 hours the test shall be called positive. If gas develops in the amount of less than 10 per cent at the end of 24 hours, or if gas develops in any amount in 48 hours, it shall be called a doubtful test. If no gas develops at the end of 48 hours it shall be called a negative test. The symbols for these results shall be (+ ? —).

2. *B. Coli Confirmation.* The State Department of Health will not require confirmation of B. coli but will accept the presumptive B. coli tests as sufficient in reporting results of filter plant operation. The manner of reporting B. coli confirmation shall be in terms of B. coli index per 100 cc.

3. *Bacteria per cc.* It was the consensus of opinion of the conference that for the purpose of determining the number of bacteria per cc, the use of agar was preferable to gelatin and that counts should be made at 20 degrees in preference to counts at 37 degrees.

The State Department of Health suggested that for those plants now equipped to make both 20 degree counts and 37 degree counts, the routine procedure would be the reporting of counts at 20 degrees for each step in the process and counts at 37 degrees for raw water and final product. Small plants not equipped with 20 degree incubators will not be expected to purchase equipment to follow the suggested routine, but will make 37 degree counts for each step in the process. The question of adopting a standard of reporting 20 degree counts in preference to 37 degree counts was left until the next conference for action.

4. *Expression of Results.* To avoid fictitious accuracy, bacterial counts shall be expressed according to the advice given in standard methods of water analysis.

5. *Media.* For medium size and large filter plants it is desired that media be prepared according to the A. P. H. A. standard methods in preference to dehydrated or desiccated preparations such as the Difco brand. For small plants and for field work the dehydrated products are reasonably satisfactory.

6. *Sterilization.* Glassware shall be uniformly sterilized according to the latest advice of the A. P. H. A., viz., 170 degrees C. for one and one-half hours. Culture media shall be sterilized according to the latest advice of the A. P. H. A., viz., steam pressure of 15 pounds for 15 minutes at a temperature of 120 degrees C.

The following determinations representing the physical and chemical tests called for in filter plant operation were discussed.

7. *Temperature.* This test should be made upon raw water and reported as degrees centigrade.

8. *Turbidity.* On account of great discrepancies in observing turbidities by different methods, it is felt that this test should be made using a candle turbidimeter. It is satisfactory to substitute an electric light for the standard candle and according to the advice given in A. P. H. A. standard methods. It was agreed that turbidities under thirty may be measured by bottle standards.

9. *Alkalinity.* To eliminate variations in al-

kalinites reported, erythrosin should be the indicator used in measuring total alkalinity. It was agreed that methyl-orange may be used in place of erythrosin but that erythrosin be used occasionally as a check upon methyl-orange.

10. *Color.* Color reported should be that in true solution and as obtained upon a water sample filtered through filter paper until the filtrate is clear. The manner of making the test should be either by the use of U. S. G. S. color disc equipment, or by the use of platinum cobalt standards.

11. *Hardness.* It is believed that hardness calculated from the calcium and magnesium content is most accurate and should be the method used in preference to the soap hardness test. The manner of determining calcium and magnesium may be either gravimetric or volumetric, preferably the latter as being the simpler.

12. *Incrustants.* Up to the present time the soda reagent method as indicated in A. P. H. A. standard methods is probably best adapted for filter plant work in determining incrustants; with the possible exception that when attempting to soften to a very low point, certain modifications of the method indicated may be desirable.

Experiences with determination of incrustants (remarks by C. P. Hover): "In testing hard water softened to a low degree, such as for boiler work, the presence of large excess of caustic alkalinity interferes with the action of the soda reagent method. Research work on an improved method under these circumstances is being carried out."

Experiences in the laboratory of the State Health Department (remarks by R. D. Scott): "In testing excessively hard waters care must be used to have an excess of the soda reagent, which may be accomplished by reducing the volume of sample tested or increasing the amount of soda reagent called for by standard methods."

13. *Iron.* The volumetric or colorimetric method of the A. P. H. A. is satisfactory.

For routine filter plant reports upon hardness, incrustants, and iron, the State Health Department will consider satisfactory these determinations upon monthly composite samples.

PART II—PLANT OPERATION

STORAGE AND SEDIMENTATION

Control of Algae Trouble. The use of copper sulphate at monthly intervals and in small amount throughout the warm weather season, beginning, say, the first day of April, has proved effective in preventing the growth of algae in reservoirs. It may prove advantageous to use the copper sulphate treatment in filtered water and well water reservoirs that are exposed and that act as equalizers on the distribution system. Some hesitancy was expressed by the conference regarding the advisability of applying copper sulphate in filtered water reservoirs.

COAGULATION

1. *Application of Chemicals.* The value and importance of purchasing chemicals on specification cannot be over-estimated. The most important chemical to specify is lime, which should be ordered on the basis of water soluable CaO.

The strength of solution to employ for coagulants should be such as to minimize clogging of the orifices.

Iron sulphate or sulphate of alumina solutions need to be agitated after the mixing up of the tank full; if mechanical agitators are available 20 minutes agitation is not too much; if compressed air only is available the same time of agitation should be used.

Avoid applying lime to the suction of the pump or ahead of a Venturi meter. Use an eductor in preference to pumping lime solutions.

Avoid using lime in plants not designed for the use of lime. The proper employment of lime requires adequate mixing chamber and settling basins.

2. *Measurements of the Amount of Chemicals.* The exact quantity of chemicals used each day is desired and should be easily obtainable. In the case of dry feed the quantity is definite, and in the case of solution feed, known strengths of solution should be employed and record made of amount used daily. It seemed to be the sentiment of the conference that some of the existing types of dry feed apparatus were not as satisfactory as is claimed by manufacturers of the device. Many expressions were heard favoring solution feed of chemicals in preference to dry feed.

3. *Secondary Coagulant Feed.* All plants operating intermittently should employ secondary feed for coagulants especially when starting up to insure the proper floc in the influent water upon the filters.

4. *Condition of Floc in Influent Water.* Besides procuring a measurable floc, it is evident that the quality of the floc produced in the influent water should be proper. For plants using sulphate of alumina an amount measurable to 15 parts per million turbidity is almost a minimum; if sulphate of iron is being used, perhaps 20. The conference expressed the opinion that it was not possible to measure the quality of floc in the influent water but that each operator would have to rely upon his own judgment as to what constituted proper floc.

FILTRATION

1. *Use of Fine Sand for Filters.* Mr. Dittoe read abstracts from his paper which was presented before the New York meeting of the American Public Health Association, November 15, 1921. (This paper was abstracted in PUBLIC WORKS for November 29, 1921.)

2. *Sand Incrustation.* A careful check on the amount of phenolphthalein alkalinity carried in the influent water for plants using lime will materially assist in keeping the growth of sand at a minimum. The alternate use of sulphate of alumina and sulphate of iron with lime as coagulants will relieve this burden somewhat.

3. *Rates of Filtration.* It was the opinion of the conference that rates of filtration should be kept as low as possible consistent with plant demands. In any event for Ohio conditions, the rates of filtration should not exceed 125 m.g.a.d.

4. *Broken Filter Runs.* When necessary to decrease the filtering capacity needed to meet peak demands, throw out of service the filters having longest been in service and wash them. Do not cut out of service a filter without washing, thinking to put it back in service later. Opinions were expressed that under certain circumstances, such as in the case of a plant having a relatively small clear well, the foregoing practice would not be possible.

5. *Long Filter Runs.* Adjust the loss of head for washing to prevent excessive long runs. Do not allow filters to become air-bound even slightly,

since such condition may disturb the mat on the filter and ruin filter efficiency.

6. *Filter Washing.* Do not wash filters too long, but leave sufficient flocculent material to provide for the initial mat upon the filter.

7. *Filtering to Waste.* In all plants provided with re-wash valves or filtered waste valves, operate these valves a sufficient time after a filter has been washed to produce a good effluent.

8. *Operation of Valves.* Open and close all valves slowly, allowing perhaps one minute for the time of operation. This applies particularly to washwater valves.

Hydraulic valves should be operated from the individual controls on the operating table and not by the water main control.

9. *Level of Sand.* Adjust the sand level in your filter plant to correspond with the rate of washwater used in washing. Make the distance between top of sand and top of washwater trough approximately equal to the rate of rise in inches employed in washing.

10. *Washing with Air and Water.* Plants having both compressed air and washwater should follow a practce of filter washing, allowing the filter to drain to about six inches water level from the top of sand. Apply air alone until well distributed. Apply water with air until water level is up to top of troughs. Shut off air and wash with water alone.

11. *Loss-of-Head Gages.* Repair your loss-of-head gages and gage the length of filter runs according to the readings of the loss of heads in preference to a schedule of washings.

12. *Special Filter Operation in Periods of Algae Trouble.*

In a paper on this subject, F. H. Waring, principal assisant engineer of the State Board of Health, advised giving regular wash to filters at same intervals as under normal conditions, and limiting time of wash to three minutes, with one or more intermediate one-minute washes. If intermediate washes are required at intervals of less than one hour, disturb clogged surface as follows: Leave sewer closed, shut effluent, turn on full wash water rather quickly and then close, put filter in service again by opening effluent. This "disturbing" may be used once or twice between partial washings. Use air instead of water for disturbing if it is available.

13. *Mud Balls.* Occurrence of mud balls usually means faulty conditions of washing of the filters. Look for underdrain troubles.

Overcome the temporary condition by scraping off mud accumulation early and remedy the washing or other difficulty.

14. *Hydraulics of Filter Underdrain and Distributing System.* Place an indicating pressure gage on the main wash water entering the manifold of each filter underdrain and distributing system, and keep watch over the pressures in washing. An increasingly high pressure denotes impending filter troubles.

15. *Effluent Taps.* Guard against an isolated bad filter condition which would ruin the whole plant efficiency by sampling the filter effluent from each filter at least occasionally. An ordinary sampling tap or spigot on the effluent line in the pipe gallery is preferable to a sampling pump for bacterial samples.

DISINFECTION

1. Apply chlorine to the filtered water.

2. The amount of chlorine applied should be from .1 to .2 parts per million if the filtered water is up to standard.

3. Liquid chlorine is preferable to the use of hypochlorite on account of dependability.

If hypo solution is to be used it is necessary to analyze each tank full in order to scientifically control the application.

Water Services and Meters

Data from more than six hundred cities concerning meters and services; including the average life in the different cities of wrought iron, steel, lead, cast iron and other services, causes of deterioration, methods of cleaning clogged sewers, unusued services laid preparatory to paving, etc.

The falling of prices has had its immediate effect upon water works construction. In some cases the connection is direct—work is being begun that had been needed for months and years but put off because of high prices. Other expenditures are indirect—low prices have stimulated building construction, and more buildings means more mains, and especially more services, and that means corporation and curb cocks, curb boxes, meters, etc. Returns made to us show present demands for a thousand miles of water mains, a hundred thousand meters and other water works appurtenances and appliances in proportion.

The tables in this issue, compiled from information furnished by over eight hundred water works officials, deal with some interesting features of water works practice. For instance, of 547 plants that use meters on residence services, 495 use ⅝-inch meters, with occasionally larger ones for unusually high demands; 32 use no size smaller than ¾-inch; while 20 use ½-inch for ordinary residences.

Wrought iron and steel, either galvanized or black, is used for services by the majority of plants, although quite a number use lead. More report using wrought iron than steel for services; and of the expectations of use this year, seven times as much wrought iron as steel is reported. One superintendent, however, expresses what is a more or less common belief when he says, in his reply to our questionnaire: "We ask and pay for wrought iron, but I suspect that we are getting steel." As the

(*Continued on page 351*)

Table I—Use of Meters and of Check Valves

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Alabama:				
Apelika	no	no	.....	¾"
Bessemer	yes	.....	.....	⅝"
Gadsden	yes	only lines supplying boilers	no	⅝" and ¾"
Jasper	yes	no	.....	⅝"
Mobile	yes	no	.....	⅝" and ¾"
Montgomery	.....	where necessary	not used in residence service	⅝"
Sheffield	yes	in some cases	no	⅝"
Talladega	yes	no	.....	⅝" and ¾"
Arizona:				
Phoenix	yes	only in extreme cases	no	⅝" and ¾"
Arkansas:				
Arkadelphia	yes	.....	no	⅝" and ¾"
Batesville	yes	no	.....	⅝"
Ft. Smith	.....	no	.....	¾" and ⅝"
Harrison	yes	no	.....	⅝" and ¾"
Jonesboro	yes	no	.....	⅝"
Mena	yes	yes	no	⅝"
Pine Bluff	yes	no	.....	⅝"
California:				
Long Beach	yes	no	.....	¾"
Pasadena	yes	no	.....	⅝" and ¾"
Pomona	no	no	consumer charged damage to meter on acc. of check	⅝" and ¾"
Riverside	no	only where boilers are used	no	⅝"
San Jose	yes	occasionally	no	⅝"
Santa Barbara	yes	no	.....	⅝"
Santa Cruz	yes	only where boilers are attached	no	.....
Colorado:				
Boulder	yes	yes	no	⅝"
Colo. Springs	yes	no	.....	only large services metered
Ft. Collins	yes	no	.....	⅝"
Greeley	yes	only where there is hot wated trouble	no	⅝"
Longmont	yes	where necessary	no	⅝"
Rocky Ford	yes	no	.....	⅝"
Connecticut:				
Ansonia	yes	no	.....	⅝"
Bridgeport	yes	no	.....	¾" and ⅝"
Danielson	yes	no	.....	.....
Derby	.....	no	.....	.....
Middletown	.....	no	no	⅝"
Norwich	placed on all new services	.....	.....	⅝"
Putnam	yes	no	.....	⅝"
Torrington	.....	no	.....	½"
Wallingford	yes	on separate hot water heaters	no	⅝"
Willimantic	yes	no	.....	⅝"
Florida:				
Gainesville	yes	no	.....	⅝"
Jacksonville	.....	.....	.....	⅝"
Lake City	no	no	.....	⅝"
Live Oak	yes	no	.....	¾"

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Indiana (Continued).				
Crown Point	yes	no	.....	⅝"
Decatur	yes	no	.....	⅝"
East Chicago	yes	yes	no	¾"
Elkhart	yes	no	hot water backs through meter and burns out parts	⅝"
Elwood	yes	some	no	⅝"
Ft. Wayne	yes	only where boilers and coils are on service	no	⅝" and ¾"
Gas City	yes	no	.....	⅝" and ½"
Greenfield	yes	in some instances	no	⅝"
Greensburg	yes	no	.....	⅝"
Huntington	yes	only where suplying steam boilers	no	⅝"
Indianapolis	no	yes	no	⅝"
Jasper	no	no	.....	¾"
Lafayette	yes	where hot water may get to meters	no	⅝"
La Porte	yes	yes	very little	⅝"
Lebanon	yes	no	.....	⅝"
Linton	yes	no	.....	⅝"
Marion	yes	.....	no	⅝" and ¾"
Mishawaka	yes	no	.....	⅝"
New Albany	no	.....	no	⅝"
New Castle	no	no	frequently	⅝"
South Bend	yes	no	.....	⅝"
Tell City	yes	no	.....	⅝" and ¾"
Terre Haute	.....	.....	.....	⅝"
Tipton	yes	where service is to boilers	no	⅝" and ¾"
Union City	yes	where there is hot water plant or coil in furnace	no	⅝"
Vincennes	yes	no	.....	⅝"
Iowa:				
Algona	yes	no	.....	⅝" and ¾"
Boone	yes	no	.....	⅝"
Burlington	.....	no	consumers pay repair if meter is damaged by hot water	.....
Cedar Rapids	yes	no	.....	⅝" on ¾" service
Council Bluffs	yes	no	.....	⅝"
Davenport	yes	no	when meter scalded consumer pays cost	⅝"
Eldora	furnished by city	no	.....	⅝"
Ft. Dodge	yes	no	.....	⅝"
Harlan	yes	on hot water only	no	⅝"
Independence	yes	sometimes	yes	⅝"
Iowa Falls	yes	no	.....	⅝"
Maquoketa	yes	where power or heating boilers are used	no	⅝"
Marion	yes	in some cases	no	⅝"
Mason City	yes	no	.....	½" and ⅝"
Muscatine	yes	with safety valve	no	⅝"
New Hampton	yes	no	.....	⅝"
Sac City	yes	no	.....	⅝"
Sioux City	no	yes	no	⅝"
Storm Lake	yes	no	.....	1"
Valley Junction	yes	yes	no	¾" and ⅝"
Washington	yes	no	.....	⅝"

Georgia:				
Athens	yee	no	.....	⅝"
Atlanta	yes	no	.....	⅝", ¾" service
Bainbridge	yes	no	.....	⅝" and ¾"
Covington	.....	no	.....	¾"
East Point	yee	no	.....	⅞"
Griffin	yes	no	.....	⅝"
La Grange	yes	no	.....	⅝"
Marietta	all serv. metered	no	.....	⅞"
Moultrie	yes	no	.....	⅝"
Pelham	yes	no	.....	¾"
Rome	yes	only on hotels and large buildings	no	⅝"
Savannah	yes	.....	.....	⅝" and ¾"
Thomasville	yee	no	.....	⅞"
Idaho:				
Boise	yes	no	.....	¾"
Illinois:				
Abingdon	yes	yes	very little	⅝"
Bloomington	yes	no	.....	⅝"
Bushnell	yee	only when necessary	recommend relief valve	⅝"
Centralia	yes	no	.....	⅝", ¾" connections
Chicago Heights	yee	if connected to hot water system	no; use safety valve	⅝" and ¾"
Christopher	yes	no	.....	⅝"
Decatur	yes	in some cases	no	⅝"
Depue	yes	yes	no	⅝"
Downers Grove	yee	no	.....	⅝"
Effingham	yes	no	.....	⅝"
Elmhurst	yes	no	.....	⅝"
Freeport	yes	no	.....	⅝"
Geneva	yee	no	.....	⅝"
Harriaburg	yes	no	.....	⅝"
Harvard	yes	only where connected to water heater	not yet	⅝", ¾" connections
Harvey	yes	yes	safety valve installed	⅝"
Lake Forest	yes	in few instances	no	⅝" and ¾"
Lawrenceville	yes	no	.....	⅝"
Lincoln	yes	no	.....	⅝"
Matteon	.....	in a few instances	no	⅝"
Moline	yes	no	.....	⅝", ¾" connections
Morrison	mostly flat rates	no	no	⅝"
Naperville	yes	.....	.....	⅝"
Peoria	yes	no	.....	⅝"
Princeton	yes	where needed	no	⅝"
Quincy	on some services	yes	no	⅝" or ¾"
Riverside	yes	no	.....	⅝"
Rock Island	yes	where meter is damaged by hot water from boilers	.....	⅞"
Rockford	yes	no	.....	⅝"
St. Charles	yes	no	.....	⅝"
Springfield	yes	no	.....	⅝"
Streator	yes	no	.....	⅝"
Vandalia	few meters	no	.....	¾"
Waukegan	yes	yes	no	⅝"
West Chicago	yes	no	.....	⅝"
Indiana:				
Auburn	yes	no	.....	⅝"
Aurora	yes	no	.....	⅝"
Bedford	yes	.....	.....	⅝"
Bluffton	yes	no	.....	⅝"
Brazil	yes	.....	.....	⅝"
Columbia City	yes	in special cases	.....	⅝"
Crawfordsville	no	no	.....	⅞"
Kansas:				
Atchison	no	no	.....	⅝"
Chanute	yee	no	no	⅝" and ¾"
Coffeyville	no	only where hydraulic elevators are used	no	⅝"
Eureka	.....	no	.....	⅝" and ¾"
Ft. Scott	yes	no	.....	⅝"
Fredonia	yes	no	.....	⅝"
Galena	yes	no	.....	¾"
Girard	yes	no	.....	⅝"
Great Bend	yes	no	.....	⅝", ¾" connections
Hays	yes	only when adjacent to boilers	no	⅝"
Hutchinson	yes	no	.....	⅝"
Independence	yes	no	.....	⅝", ¾" connections
Lyons	yes	a few	install pressure regulator and relief valves	⅝"
McPherson	yes	no	.....	⅝"
Olathe	.....	no	.....	⅝"
Osawatomie	yes	no	.....	⅝"
Pittsburg	yes	no	.....	⅝"
Salina	yes	where hot water backs up to meter	no	⅝"
Topeka	yes	.....	.....	⅝"
Kentucky:				
Ashland	yes	no	.....	⅝"
Catlettsburg	no	no	.....	⅝", ½" connections
Covington	yes	.....	.....	⅝"
Lexington	yes	not general on residences	no	⅞"
Louisville	yes	yes	no	none
Morganfield	yes	no	.....	⅞"
Providence	yes	sometimes	no	½" and ⅝"
Louisiana:				
Baton Rouge	yes	on some with tank pressure	no	⅝"
Leesville	yes	no	.....	⅝"
Rayne	yee	no	.....	⅝"
Maine:				
Augusta	yee	in laundries	no	⅝" and ¾"
Bath	no	yes	no	⅝", ¾" connections
Eastport	.....	no	.....	⅝"
Lewiston	no	no	.....	⅝"
Portland	yes	no	yes; when check used	½"
Maryland:				
Chestertown	.....	no	.....	¾"
Hagerstown	yes	yes	no	⅝"
Massachusetts:				
Andover	.....	no	no	⅝"
Arlington	yes	.....	.....	⅝"
Athol	yes	no	.....	⅝"
Belmont	yes	where there is pressure boiler	yes	⅞"
Boston	.....	.....	.....	⅝"-1"
Brockton	yes	no	.....	¾"
Brookline	.....	where hot water is liable to flow back	no	⅝"
Cambridge	optional with water dept.	.....	.....	⅝" on ¾" pipe
Clinton	.....	.....	.....	⅝"
Concord	.....	no	.....	none
Danvers	yes	against hot water	yes	⅝"
Dedham	.....	no	.....	⅝"
Easthampton	no	no	.....	⅝"
Everett	yes	no	.....	⅞"

Use of Meters and Check Valves—Continued

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Massachusetts (Continued).				
Fairhaven	yes	no	.....	5/8"
Fitchburg	yes	some	no	5/8"
Framingham	yes	no	.....	5/8"
Haverhill	yes	no	.....	5/8"
Hudson	yes	no	.....	5/8"
Lawrence	yes	no	.....	5/8" to 3/4"
Lenox	no	no	.....	5/8" to 3/4"
Maynard	yes	no	.....	5/8"
Medford	yes	no	.....	5/8"
Milford	yes	no	.....	5/8"
Montague	no	.....	.....	.....
Needham	yes	no	.....	5/8"
New Bedford	yes	no	.....	5/8", 3/4" and 1" occasionally
N. Attleborough	no	only on sizes supplying boilers	no	5/8"
Norwood	yes	no	.....	5/8"
Oxford	yes	no	.....	5/8"
Peabody	yes	no	.....	5/8"
Reading	yes	no	.....	5/8"
Springfield	yes	on 3" up	no	5/8"
Swampscott	yes	no	.....	5/8"
Taunton	yes	no	.....	5/8"
Waltham	yes	no	.....	5/8"
Wareham	yes	no	.....	5/8"
Wellesley	no	when asked only	no	5/8"
Westboro	yes	no	.....	5/8"
Winthrop	yes	no	.....	5/8" single houses; 3/4" double and apartments
Wrentham	optional	no	.....	5/8"
Michigan:				
Alma	yes	no	.....	5/8"
Ann Arbor	yes	when necessary	very few	5/8"
Battle Creek	no	no	few long ago	5/8"
Big Rapids	no	.....	.....	3/4" when used
Detroit	yes	no	.....	5/8"
Dowagiac	yes	in some cases	no	5/8"
Escanaba	yes	where hot water heating	no	5/8"
Gladstone	yes	on large meters	.....	5/8"
Greenville	yes	no	.....	5/8"
Highland Park	yes	yes and diaphragm relief valves	no	5/8"
Holland	yes	no	.....	5/8"x5/8"
Ironwood	no	no	.....	5/8"
Marine City	no	flat rate	.....	.....
Marquette	yes	no	.....	5/8"
Marshall	yes	no	.....	5/8"
Menominee	.....	some	no	5/8"
Mt. Clemens	.....	no	.....	5/8"
Mt. Pleasant	.....	no	.....	5/8", 3/4" connec'ns
Niles	yes	no	.....	5/8"
Onaway	yes	no	.....	1/2" & 3/4"
Rochester	yes	yes	no	5/8"
Saginaw	yes	no	.....	only meter large services
St. Clair	yes	no	.....	5/8", 3/4" connec'ns
South Haven	yes	in few cases where relief is installed	no	5/8"
Sturgis	yes	on hot water heating systems only	.....	5/8"
Three Rivers	no	only on large heating plants	.....	5/8", 3/4" hubs
Traverse City	yes	no	.....	5/8"
Wakefield	yes	no meters	.....	no meters

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Nebraska (Continued).				
McCook	yes	no	.....	5/8"
North Platte	yes	no	.....	5/8"
Schuyler	.....	no	.....	5/8"
Sidney	yes	.....	.....	5/8" & 3/4"
University Pl	yes	no	.....	5/8"
New Hampshire:				
Berlin	yes	up to consumer	some	5/8"
Claremont	yes	where necessary	no; relief valves used	5/8", 3/4" connections
Concord	yes	no	.....	5/8" & 3/4"
Dover	yes	no	.....	5/8" & 3/4"
Keene	yes	no	.....	5/8"
Lebanon	no	no	.....	5/8"
Portsmouth	.....	no	.....	5/8"
New Jersey:				
Bound Brook	yes	in some cases	no	5/8" & 3/4"
Bridgeton	yes	no meters	.....	.....
Dunellen	yes	no	.....	5/8" & 3/4"
Freehold	yes	no	.....	5/8"
Hawthorne	yes	no	.....	5/8"
Hightstown	yes	no	.....	5/8"
Milltown	by boro ordinance	yes	no	5/8", 3/4" spuds
Nutley	yes	no	.....	5/8"
Phillipsburg	.....	no	.....	5/8"
Ridgewood	yes	.....	.....	5/8" & 3/4"
Rockaway	yes	no	.....	5/8" & 3/4"
New Mexico:				
Silver City	yes	no	.....	5/8" & 3/4"
New York:				
Albany	yes	when necessary	no	5/8"
Amityville	.....	no	.....	5/8"
Auburn	yes	no	.....	5/8"
Avon	.....	on some	yes	5/8"
Babylon	.....	.....	.....	5/8"
Baldwinsville	no	where required	.....	none metered
Brockport	yes	no	.....	5/8"
Buffalo	city ordinance	no	.....	5/8"
Canastota	yes	no	.....	5/8"
Catskill	no	no	.....	5/8", 3/4" connec'ns
Clyde	no	no	.....	5/8"
Corning	yes	yes	no	5/8"
Cortland	yes	no	.....	5/8"
East Aurora	yes	no	.....	5/8"
Elmira	yes	no	.....	5/8"
Fairport	yes	no	.....	5/8"
Fort Plain	no	when boilers attached	no	5/8"
Frankfort	yes	no	.....	1/2" or 5/8"
Freeport	yes	no	.....	.....
Geneva	yes	yes	.....	5/8"
Glens Falls	yes	on some industrial services	no	5/8"
Gloversville	yes	yes	no	5/8" & 3/4"
Hamburg	yes	no	.....	5/8"
Hoosick Falls	no	no	.....	1", 1 1/4", 5/8"
Hudson	yes	no	.....	5/8"
Hudson Falls	yes	yes	no	1/2"
Ithaca	yes	in rare cases	no	5/8"
Jamestown	yes	few	no	3/4"
Le Roy	yes	no	.....	5/8"
Lyons	yes	no	.....	5/8", 3/4" connec'ns
Middletown	yes	no	.....	5/8"
Mohawk	yes	no	.....	5/8"
Mount Morris	yes	no	.....	5/8"

Minnesota:				
Aurora	yes	no	.....	5/8"
Brainerd	97% metered	used by individuals	in few cases to meters only	5/8"
Cloquet	yes	no	.....	5/8"
Crookston	yes	no	.....	5/8" & 3/4"
Duluth	never tested	no	.....	5/8"
Hastings	yes	yes	no	5/8"
Hutchinson	yes	no	.....	5/8"
Lake City	yes	on all hot water and range boilers	.....	.....
Little Falls	no	no	no	5/8"
Luverne	yes	no	.....	5/8"
Minneapolis	yes	no	.....	3/8" dup and apt 3/4"
Northfield	yes	no	.....	5/8"
Pipestone	yes	when connected to boiler	.....	5/8"
St. Cloud	yes	no	no	5/8"
St. Paul	yes	yes	.....	5/8"
Staples	yes	no	no	5/8"
Stillwater	yes	no meters	.....	3/4"
Two Harbors	no	no meters	.....	.....
Waseca	yes	no	.....	5/8"
W. Minneapolis	yes	yes	.....	5/8"
Worthington	yes	no	no	5/8"
Mississippi:				
Canton	yes	only where there is hot water trouble	no	5/8" x 3/4"
Clarksdale	yes	no	.....	5/8"
Greenville	yes	where steam boilers are used	no	5/8" x 3/4"
Greenwood	yes	no	.....	5/8"
Grenada	yes	no	.....	5/8"
Jackson	yes	on high pressure steam boilers	no	5/8" x 3/4"
Laurel	.....	.....	.....	5/8"
Meridian	yes	no	.....	5/8"
New Albany	yes	no	.....	5/8"
Winona	all metered	no	.....	5/8" & 3/4"
Missouri:				
Butler	yes	no	.....	.....
Hannibal	yes	yes	.....	5/8"
Jefferson City	yes	no	.....	5/8"
Lebanon	yes	no	.....	5/8"
Liberty	all metr'd	a few	no	5/8"
Macon	no	in some cases	.....	5/8" or 3/4"
Marceline	.....	no	.....	3/4"
St. Louis	yes	where hot water damage occurs	.....	5/8"
Trenton	yes	where necessary	no	5/8"
Webster Grove	yes	no	.....	5/8"
Montana:				
Anaconda	yes	no meters	.....	.....
Billings	yes	when meters damaged by water from boilers	in few cases	5/8"
Glendive	yes	where close to hot water line	no	5/8"
Great Falls	yes	no	.....	3/4"
Missoula	yes	when there are boilers	require safety valves	flat rate
Nebraska:				
Aurora	.....	.....	sometimes hot water backs into meters	3/4"
Chadron	yes	no	.....	5/8"
Fairbury	yes	no	.....	5/8" & 3/4"
Fremont	yes	no	.....	5/8" & 3/4"
Gering	yes	yes	no	5/8"
Hastings	yes	no	.....	5/8"
Lincoln	yes	.....	.....	5/8"
Mount Vernon	yes	yes	no	1/2" & 3/4"
Newark	yes	no	.....	5/8"
New York	on business premises only	in bldgs. supplied from 2 mains & supply to boilers	no	5/8", 3/4" spuds
Norwich	not known	only when hot water has backed through meter	.....	
Nyack	at option of bd.	when liable to back pressure	no	5/8"
Ogdensburg	yes	yes	no	.....
Olean	all metr'd	no	.....	5/8"
Oneonta	yes	no	.....	5/8"
Ossining	no	no	.....	5/8"
Oswego	yes	yes	no	5/8"
Perry	for industrial purposes	no	.....	.....
Rochester	yes	only on large sizes	no	5/8"
Salamanca	yes	only on boilers under st'm pressure	.....	5/8"
Saratoga Sp'ngs.	yes	no	.....	5/8"-3/4"
Scotia	city furn. meters	no	.....	5/8"
Seneca Falls	yes	no	.....	5/8"
Sidney	yes	no	.....	.....
Syracuse	99%	where 2 mains on large meters	no	3/4" & 5/8"
Tarrytown	yes	not in all cases	possibly	5/8"
Wappingers Falls	yes	no	.....	5/8"
Waterford	yes	no	.....	5/8" & 3/4"
Waterloo	.....	no	.....	5/8"
Watertown	some	no	.....	5/8"
Watervliet	yes	not ordinarily	no	5/8"
Wellsville	yes	no	.....	5/8"
Westfield	no	no	.....	3/4"
Yonkers	yes	.....	.....	5/8"
North Carolina:				
Canton	yes	no	.....	5/8"
Greensboro	yes	no	.....	5/8"
High Point	no	no	.....	3/4", 3/4" connec'ns
Lenoir	yes	yes	no	3/4"
Monroe	.....	no	.....	5/8", 3/4" serv. pipe
Morehead City	no	no	.....	1/2" & 3/4"
Mount Airy	yes	only on boiler services and cross connections w. private supplies	no	5/8"
New Bern	yes	only when trouble from hot water	no	5/8", 3/4" connec'ns
Rocky Mount	yes	no	.....	5/8"
Salisbury	yes	only certain hot water supplies	no	5/8", 3/4" connec'ns
Wilmington	yes	no	.....	5/8"
North Dakota:				
Fargo	yes	no	.....	5/8" & 3/4"
Grafton	yes	no	.....	5/8"
Valley City	yes	no	.....	5/8"
Wahpeton	yes	no	.....	3/4"
Williston	yes	some	yes	5/8"
Ohio:				
Ashtabula	yes	.....	.....	5/8"
Barberton	yes	no	.....	5/8", 3/4" connec'ns
Barnesville	yes	no	.....	5/8"
Bryan	yes	no	.....	5/8"
Cambridge	yes	no	.....	3/4" to 5/8"
Cincinnati	yes	in case of water heaters	no	5/8"
Cleveland	yes	not on 1" or less	no	5/8"
Cuyahoga Falls	.....	.....	.....	5/8"
Dayton	.....	where there is hot water	no	1/2"
East Liverpool	yes	on large services	no	5/8" and 3/4"

Use of Meters and Check Valves—Continued

Municipality	Can their use be legally required?	Are check valves used at meters?	Have check valves damaged kitchen boilers or house piping?	Size of meters for ordinary residences.
Ohio (Continued).				
E. Youngstown	.....	no	.....	⅝"
Eaton	yes	when necessary	no	½" and ⅝"
Franklin	yes	on large meters	no	⅝"
Kenmore	yes	no	.....	⅝"
Lakewood	yes	no	.....	⅝", ½" couplings
Lancaster	yes	no	.....	⅝" or ¾"
Lima	yes	no	.....	.....
Lorain	yes	no	.....	⅝"
Marysville	yes	some	no	⅝" and ¾"
Medina	yes	no	.....	⅝", ½" connections
Middletown	yes	no	.....	⅝"
Mingo Junction	yes	no; stop valve	no	⅝"
Montpelier	yes	no	.....	⅝"
Newark	yes	no	.....	⅝"
New Boston	by ordinance	on outlet	in few cases	⅝",
New Phila.	yes	no	.....	⅝"
Niles	yes	no	.....	⅝"
Portsmouth	by ordinance	no	.....	⅝" and ¾"
Sandusky	yes	on some	no	⅝"
Springfield	yes	when connected with boilers	no	⅝"
Tiffin	yes	yes	no	⅝", ¾" connections
Wadsworth	yes	no	.....	⅝"
Warren	yes	no	.....	⅝"
Willoughby	yes	no	.....	⅝"
Youngstown	yes	no	.....	⅝"
Zanesville	yes	no	.....	⅝"
Oklahoma:				
Cleveland	yes	no	.....	¾"
Collinsville	yes	no	.....	⅝"
Hartshorne	yes	safety valve on hot water boilers	no	⅝"
Holdenville	yes	no	.....	⅝"
Newkirk	yes	no	.....	⅝"
Sand Springs	yes	no	.....	⅝"
Pennsylvania:				
Allentown	yes	yes	no	⅝"
Bloomsburg	no	no	.....	.....
Catasauqua	yes	.....	.....	⅝"
Chambersburg	yes	when hot water sets back	no	⅝", ¾" couplings
Chester	yes	no	.....	⅝"
Coatesville	no	no	.....	⅝" and ¾"
Connellsville	partly	in some cases	no	⅝"
Coudersport	.....	no	.....	none
Corry	yes	few	no	⅝" and ½"
Downingtown	yes	no	.....	⅝"
Duquesne	yes	on property side	no	⅝"
Ellwood	yes	no	.....	⅝"
Hamburg	yes	no	.....	⅝"
Honesdale	yes	no	.....	¾"
Huntingdon	yes	not regularly	no	no meters
Indiana	.....	yes	.....	⅝" and ¾"
Jenkintown	yes	yes	no	¼" and 1"
Jersey Shore	yes	only when hot water is apt to back up to meter	no	⅝" and ¾"
Juniata	borough legislation	no	.....	¾"
McDonald	yes	no	.....	⅝"
McKees Rocks	.....	no	.....	⅝"
Manheim	yes	no	.....	⅝"
Texas (Continued).				
Sweetwater	yes	no	.....	½" and ¾"
Teague	.....	no	.....	½"
Texas City	all metered	at certain hot water appliances	no	⅝" and ¾"
Waco	yes	only on fire line service	hot water backs up in meter	.....
Vermont:				
Barre	yes	no	.....	⅝"
Proctor	no	.....	.....	.....
Springfield	yes	no	.....	⅝"
Virginia:				
Charlottesville	to meter 100%	no	.....	⅝" and ¾"
Harrisonburg	yes	no	.....	⅝", ¾" connections
Lynchburg	by ordinance	no	.....	⅝" and ¾"
Martinsville	no	some	none	⅝"
Richmond	yes	occasionally; also safety valve near boiler	no	⅝" and 1"
Staunton	yes	no	.....	⅝"
Washington:				
Seattle	placed on each new serv.	no compulsion	no	½", ¾" and 1"
Spokane	yes	no	.....	⅝" and ¾"
West Virginia:				
Charleston	Pub. Serv. Com. orders	only in boiler rooms	no	⅝"
Moundsville	Pub. Serv. Com.	no	.....	⅝"
Salem	yes	no	.....	⅝"
Sistersville	no	no	.....	¾"
Welch	yes	no	.....	⅝"
Wisconsin:				
Appleton	yes	in some locations	no	⅝"
Clintonville	yes	only when connected to high pressure boilers	.....	⅝"
Delavan	yes	no	.....	⅝"
Fond du Lac	no	where hot water plants connected	.....	⅝"
Ft. Atkinson	yes	no	seldom	⅝" and ¾"
Green Bay	yes	no	.....	⅝"
Hartford	yes	no	.....	¾"
Janesville	yes	no	.....	⅝"
Jefferson	all metered	no	consumer responsible for meter	⅝"
Kaukauna	yes	only where required for steam boilers	no	⅝"
Lake Geneva	yes	yes	no	4" to ⅝"
Madison	yes	no	on heater lines only	⅝"
Manitowoc	yes	yes	no	⅝"
Marinette	yes	only where there is hot water connection	no	⅝"

Media	Pub. Serv. Com.	yes	no	¾"			¾" and ¾"
Meyersdale	no	no	.....	¾"	yes	only if hot water backs up	¾" and ¾"
Millersburg	Pub. Serv. does	no	.....	¾"	yes	only where supply comes from two streets	no	¾" and ¾"
North East	yes	no	very seldom	¾"				¾"
Red Lion	yes	yes	no	¾"				¾"
Reynoldsville	no	both	no	flat rate				¾" and ¾"
Royersford	yes	no	no	½"	yes			¾"
Sayre	no	no	.....	¾" and ¾"	yes			¾"
Sharpsville	yes	no	.....	¾"	yes			¾"
Sykesville	yes	yes	no	¾"	yes			¾"
Tamaqua	no	no	.....	¾"	yes			¾"
Titusville	yes	yes	no	¾"	yes			¾"
Uniontown	yes	no	.....	¾"	yes			¾"
Warren	no	no	.....	¾"	yes			¾"
Wellsboro	yes	no	.....	¾"	yes			¾"
Wilkinsburg	yes	no	.....	¾"	yes			¾" and ¾"
Williamstown	no	at plant of Lt. Co.	.....	¾"	yes			¾"
York	yes	yes	.....	¾"	yes			¾"
Rhode Island:								
Woonsocket	yes	no	.....	¾"	yes			¾"
South Carolina:								
Anderson	yes	where hot water heating systems are used	no	¾"	yes			¾" and ¾"
Batesburg	yes	no	.....	¾"	yes			¾"
Bennettsville	by ordinance	only in special cases	no	¾", ¾" connections	yes			.....
Camden	yes	no	.....	¾" and ¾"	yes			¾"
Charleston	yes	not generally	.....	¾", ¾" connections	yes			
Cheraw	yes	no	.....	¾", ¾" connections	yes			
Clinton	yes	no	.....	¾"	yes			
Easley	yes	in some cases	no	¾"	yes			
Spartanburg	rule of bd.	no	.....	¾", ¾" service	yes			
South Dakota:								
Aberdeen	yes	no	.....	¾"	yes			
Tennessee:								
Elizabethton	yes	no meters	.....	.....	yes			
Erwin	yes	no	.....	¾"	yes			
Greeneville	yes	no	.....	¾"	yes			
Lebanon	mun. owned	no	.....	¾"	yes			
Memphis	yes	in some cases	no	¾"	yes			
Newport	yes	no	.....	¾"	yes			
Shelbyville	yes	yes	disturbing noises	¾"	yes			
Trenton	yes	no meters	.....	.....	yes			
Texas:								
Austin	yes	no	.....	¾"	yes			
Cleburne	yes	no	.....	¾" and 1"	yes			
Cleburne	yes	no	.....	¾", 1" and 1½"	yes			
Cooper	yes	no	.....	¾"	yes			
Dalhart	optional	no	.....	¾"	yes			
Electra	yes	no	.....	¾"	yes			
Hearne	yes	no	.....	¾" and ¾"	yes			
Henrietta	yes	yes	no	¾"	yes			
Mart	yes	no	.....	½" and ¾"	yes			
Quanah	yes	where boilers are on line	no	¾" and ¾"	yes			
San Antonio	no	sometimes	no	¾"	yes			
Smithville	yes	no	.....	¾"	yes			
Stamford	yes	no	.....	¾" and ¾"	yes			
Menasha	yes	only if hot water backs up	no	¾" and ¾"
Milwaukee	yes	only where supply comes from two streets	no	¾" and ¾"
Mineral Point	yes	no	.....	¾"
Monroe	yes	no	.....	¾"
Neenah	yes	when connected to hot water system	no	¾" and ¾"
New London	yes	no	.....	¾"
Park Falls	yes	no	.....	¾"
Platteville	yes	no	.....	¾"
Plymouth	yes	no	.....	¾"
Racine	yes	in some cases	no	¾"
Reedsburg	yes	no	.....	¾"
Rice Lake	yes	yes	no	¾"
Richland Center	yes	no	.....	¾"
Shawano	no	no	.....	¾"
Milwaukee	yes	no	no	¾"
Sparta	no	no	.....	¾" and ¾"
Stevens Point	yes	no	.....	¾"
Sturgeon Bay	yes	no	.....	¾"
Superior	yes	no	.....	¾"
Tomah	yes	no	.....	¾"
Tomahawk	yes	yes	no	¾"
Viroqua	yes	no	.....	¾"
Watertown	ordinance	only on boilers	.....	¾"
Wauwatosa	yes	no	.....	¾" and ¾"
Wyoming:				
Cheyenne	yes	no	.....	¾"
Evanston	yes	no meters	.....	.....
Rawlins	yes	no	.....	¾"

(Continued from page 345)

former costs about 80 per cent. more than the latter, it would seem to be worth while to make sure of getting what is paid for.

Even more interesting are the opinions given as to the lives of services of the different materials. In all cases where comparisons are made, we believe, wrought iron is assigned a longer life than steel, and lead much longer than either. A few such comparisons (using the abbreviations for brevity) are: S, 20; wi, 35; l, 50. S, 5 to 10; wi, 25 to 30. Wi, 15; l, 25 to 35. S, 15; wi, 30. S, 12; wi, 25; l, 50. S, 2 to 8; l, 30. Wi, 15; l, permanent. S, 15; l, indefinite. Wi, 15 to 20; lead lined, indefinite. Gal., 20 to 25; cement lined, 50. The causes of deterioration are generally given as rust or corrosion; although quite a number report electrolysis, and a few freezing and bursting of lead pipes.

Several hundred describe briefly the methods they employ in removing stoppages from service pipes. These include rodding, forcing wads of tissue paper through, use of force pumps, pumping muriatic acid through, running wires, tapes or small pipes through; while many make no effort at cleaning but renew all clogged services. An unexpected number report that they are not troubled with clogging of service pipes. This is true of seven cities out of eight in Alabama, six out of seven in Arkansas, all in California, thirteen out of seventeen in Kansas, etc. On the other hand, all Maine cities report such trouble, and twenty-three of thirty-six in Massachusetts.

Table II—Water Works Services

Note: In the table, ci. means cast iron; cl., cement lined; gi., galvanized iron; gs., galvanized steel; gwi., galvanized wrought iron; i., iron; ll., lead lined; s. steel; wi. wrought iron.

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
Alabama:					
Bessemer	½" g.	15	corrosion	no	.....
Gadsden	g.	15-20	rust	no	.....
Jasper	g.	10	rust	no	.....
Mobile	wi.	8	rust	yes	rodding
Montgomery	i.	30 and more	electrolysis	no	.....
Opelika	ci. and cl.	.....	.....	no	.....
Sheffield	g. and l.	30	rust	no	.....
Talladega	g.	20	action of soil	no	.....
Arizona:					
Phoenix	g. and wi.	15	elect., rust and corrosion	yes	flushing
Arkansas:					
Arkadelphia	ci.	.....	.....	no	.....
Batesville	¾" g.	20 and more	.....	no	.....
Ft. Smith	g.	18-20-35	rust	little	.....
Harrison	g.	20	rust	no	.....
Jonesboro	wi.	6 and more	.....	no	.....
Mena	¾" g.	20	rust	no	.....
Pine Bluff	¾" g.	15-25	rust	no	.....
California:					
Long Beach	gs.	g. 15; l. 40	rust	no	.....
Pasadena	s. and ¾" g.	20	elect., corrosion	no	.....
Pomona	wi.	20-30	rust	no	.....
Riverside	wi.	25	elect., rust	no	.....
San Jose	s.	30	elect., rust, alkali	no	.....
Santa Barbara	wi.	10-20 (a)	chem. action of soil	no	.....
Santa Cruz	wi.	25-30; s. 5-10	.....	....	replaced with new
Colorado:					
Boulder	wi.	20	.....	no	.....
Colo. Springs	s., wi., l.	s. 20; wi. 35; l. 50	rust	rust only	renew
Ft. Collins	wi.	15-25	rust	no	.....
Greeley	l.	.....	.....	no	.....
Longmont	l., wi., s.	s. 6-30	rust, corrosion	yes	renew
Rocky Ford	l. under pav., rest g.	g. 6-15	from sediment in water	....	laying new ones
Connecticut:					
Ansonia	wi.	.....	rust	....	.....
Danielson	gs.	20	rust	some	extension rods
Derby	.....	.....	clogging	yes	pipes renewed
Middletown	wi.	25-30	clogging	yes	force pump
Norwich	l.	.....	electrolysis	yes	blow them
Putnam	g.	25	rust—det. at joints	yes	relay, mostly
Torrington	s., wi., l.	.....	rust	yes	lay new pipe
Wallingford	wi.	¾", 30-35; 1", 40-50	rust	....	.....
Willimantic	l.	35	.....	no	.....
Florida:					
Gainesville	wi., l. ci.	wi., 10-20	wi.—rust	no	.....
Jacksonville	g.	15-25	elect., rust	no	.....
Key West	l.	.....	.....	very little	.....
Lake City	i. and l.	.....	.....	no	.....
Live Oak	l	.....	.....	....	.....
Georgia:					
Athens	g.	15	none	yes	renewed
Atlanta	wi., l. connect.	15-20	.....	....	.....
Bainbridge	wi.	10	rust	no	.....
Covington	gs.	.....	.....	no	.....
East Point	g.	10	electrolysis	no	.....
Griffin	wi.	15	rust	few	renew
La Grange	gs.; ll. under new pavements	s., 20	rust	little	renew
Marietta	wi.	30	rust	none	.....
Moultrie	wi.	12	corrosion	no	.....
Pelham	l. and wl.	.....	.....	yes	renew
Rome	s. and wi.	15	elect., rust	no	.....
Savannah	s., wl., l., cl.	wl., 10	rust	little	flushing
Thomasville	gs.	18-20	rust	....	.....
Idaho:					
Boise	g.	25	elect., ordinary det.	no	.....
Illinois:					
Abingdon	i. and l.	i., 10	rust	no	.....
Bloomington	l., ci.	l., 30	bursting of lead pipe freezing	yes	pump acid thru; sometimes comp. air
Bushnell	s. and l.	i., 5-20	rust, action of water	no	.....
Centralia	l. and g.	g., 10-20	rust	yes	services renewed
Chicago Heights	l.	.....	electrolysis	some	disconnect and clean
Christopher	s. and l.	s., 6-8	elect. and rust	yes	renew
Decatur	g., wl.	25	.....	no	.....
Depue	l., g.	.....	rust	no	.....
Downers Grove	l.	i., 3	rust	no	.....
Effingham	wi. and l.	i., 12, l.-25	rust	no	.....
Elmhurst	l.	.....	.....	no	.....
Freeport	l.	30	fill. w. sediment	occasionally	renew serv.
Geneva	l.	18	rust	no	.....
Harrisburg	wi. and l.	wi.-15, l., 25-35	rust	no	.....
Harvard	l.	.....	rust	some	muriatic acid
Harvey	l.	25-40	cinders	no	.....
Lake Forest	l.	wi.-18	rust	no	.....
Lawrenceville	g.	5	curb stops, rust off service. Line pitted	seldom	.....
Lincoln	wi.	20	rust., elect.	little	force pump
Mattoon	wi. and g., s.	s., 15, wi. 30	elect., rust	no	.....
Moline	l., g.	25	elect., rust	no	.....
Morrison	g., wi.	.....	rust	no	.....
Naperville	l.	.....	.....	no	.....

*For footnotes see page 359.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
Illinois (Continued).					
Peoria	l.	.....	electrolysis	some	force pump
Princeton	l., i. and s.	l. and s.-15-20	rust	occasionally	flushing
Quincy	l., ci.	c.-3-15	rust	no	.....
Riverside	l., wi.	wi., 8-10	elect. & minerals in water	yes	.....
Rock Island	l.	.....	.....	....	.....
Rockford	l.-up to 1¼ ci.-2" up	.....	elect., rust	no	.....
St. Charles	l.	.....	.....	no	.....
Springfield	l., wl.	50	iron in water	yes	force pump
Streator	g., wi., l.	.....	.....	no	.....
Vandalia	wi.-unpaved and l., pav. sts.	.....	rust	some	flushing
Waukegan	l., wi.	wi., 20-30	rust	no	.....
West Chicago	l.	.....	none	no	.....
Indiana:					
Auburn	l.	.....	elect.	some	pump out
Aurora	wi. and l.	7-10	rust	....	.....
Bedford	s. and wi.	12-16	rust	no	.....
Bluffton	l.	.....	.....	no	.....
Brazil	g.	25	rust	no	.....
Columbia City	l.	.....	electrolysis	yes	pumping
Crawfordsville	g., wi.	20	.....	yes	take out gooseneck
Crown Point	l.	none in 25 yrs.	.....	yes	flexible ribbon sometimes prevents renewal
Decatur	l.	none in 25 yrs.	.....	....	.....
East Chicago	l. g.	.....	.....	....	.....
Elkhart	l.	.....	.....	occasionally	wired
Elwood	wi.	15	electrolysis	....	.....
Ft. Wayne	l.	40	little elect.	....	force pump
Gas City	.....	.....	.....	yes	dig up and clean
Greenfield	wi.	10	rust	yes	flush
Greensburg	g.	15	action of earth salts and imperfect pipe	yes	pumping wad of paper through
Hobart	l.	.....	mechanical defect	yes	air
Huntington	l.	s., 12; wi. 25; l. 50	electrolysis	.005%	force pump
Indianapolis	l.	50	.....	no	.....
Jasper	.....	10-20	.....	no	.....
Lafayette	l.	48 and more	water hammer, elect.	yes	force pump
Lebanon	l. and i.	.....	rust., elect.	no	.....
La Porte	l., gwi.	l.-50; rest-30	rust	no	.....
Linton	wi.	15	pitting	some	insert wire and flush
Marion	g.	20	rust., elect.	no	.....
Martinsville	ci.	25	none	in serv. lines	blow out
Michigan City	l., wi.	20-50	rust	no	.....
Mishawaka	l.	i.-15	corrosion due to soil	some	flexible rod
New Albany	g., wi.	15	elect. mostly	....	force pump
New Castle	gwi.	25-30	rust, elect.	little	flexible ribbon sometimes soft material
South Bend	l.	.....	.....	yes	renew
Tell City	s. and ci.	8-10	elect., rust	no	.....
Terre Haute	l.	s.-20	electrolysis	no	.....
Tipton	g., l.	10-20	elect., rust, defect. pipe	no	.....
Union City	l. and s.	l.-30; s., 2-8	elect., rust	no	.....
Vincennes	wl.	35	elec., weakness in lead gooseneck	no	.....
Whiting	l. and g.	.....	no elect.	no	.....
Iowa:					
Algona	wi., l.	10-12	rust	some	.....
Boone	l.	.....	.....	no	.....
Burlington	wi. g., l., ll.	15-i.	rust, elect.	....	.....
Cedar Rapids	l., i.	i.-15-30	rust	no	.....
Council Bluffs	cl., l.	depreciate c.i. 1% and g. 7%	elect., rust	yes	none cleaned
Davenport	l; 1" or more wi. or ci.	.....	l. above 1" bursts because of raising fire pressure in mains	no	.....
Eldora	g., l.	10	elect., rust	no	.....
Ft. Dodge	l. und. pav., wl. inside lot line	.....	.....	yes	.....
Harlan	wi., l.	s-short	electrolysis	no	flush
Independence	l.	4-5	rust	yes	renew
Iowa Falls	l.	.....	.....	some	.....
Maquoketa	wi. and l.	wi.-15; l-permanent	rust	no	.....
Marion	l.	.....	.....	....	.....
Mason City	l.	.....	.....	no	.....
Muscatine	l.	50	none	no	.....
New Hampton	g., l.	i., 12-14	rust	seldom	install new
Sac City	l. gooseneck; some gs.	i., 20; s., less	rust	no	.....
Sioux City	l.	12-30	none	yes	.....
Storm Lake	wi.	12	rust	no	.....
Valley Jct.	wi.	.....	.....	....	.....
Washington	l.	.....	none	no	.....
Kansas:					
Atchison	wi.-; s., formerly	s., 20	rust	very little	force pump—back pressure
Chanute	l. and s.	s.-3-12; l.-18+	.....	no	.....
Coffeyville	gs. and l.	s.-15; l.-Indefinitely	rust—s.	no	.....
Eureka	ci. and g.	30+	.....	no	.....
Fort Scott	g.	20	corrosion	no	.....
Fredonia	wi. and l.	.....	l., bad joints; wi., rust	no	.....
Galena	ci.	38+	.....	no	.....
Girard	l.	.....	.....	....	.....
Great Bend	gs.	20-30	rust	no	.....
Hays	ci., wl.	small s.; sew.-7	rust, chem. action	no	.....

*For footnotes see page 359.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
Kansas (Continued).					
Hutchinson	g., wi.	.....	elect., rust	not much	flushing services
Independence ..	g., wi. and gs.	s., 4-15 wi., 10-30	electrolysis	yes	.....
Lyons	s.	.....	rust	no	.....
McPherson	l. under pavt. rest wi.	20-25	rust	no	.....
Osawatomie	l.	.....	none	no	.....
Pittsburg	l.-paved sts., wi.-unpaved	l.-20	electrolysis	no	.....
Salina	g.-l. (b)	g., 15-20	.....	no	.....
Topeka	l., wi.	l., 30; wi. 15	.....	yes	acid
Kentucky:					
Ashland	gwi.	30+	elect., acid in soil	no	.....
Catlettsburg ...	gwi.	25	electrolysis	no	.....
Covington	l.	.....	.....	....	.....
Hazard	gs.	.....	rust	....	.....
Lexington	l.	.....	electrolysis	no	.....
Louisville	l.	.....	damage by other pub. serv. corporations	very little	flushing
Morganfield ...	l.	30+	.....	....	.....
Providence	l. and g.	g., 7	rust	....	.....
Louisiana:					
Baton Rouge ..	l.	.....	few necessary	no	.....
Kentwood	s.	9+	.....	very little	.....
Leesville	s.	10	rust	yes	dig up and renew
Rayne	g.	10+	damages from cars on side sts.	no	.....
Maine:					
Augusta	ll.	s., 15, wi. 20—	rust	yes	Staples service pipe cleaner
Bath	wi.	20	rust	yes	by pressure pump
Eastport	gs.	5-20	rust	some	.....
Lewiston	wl. and ll. (d)	wl., 15-20 ll.-indef.	rust on wi.	yes	by turn. rod and cutter Staples clean mach.
Portland	gwi. and cl.	g.-20-25 cl.-50	rust	yes	¼" block tin pipe
Maryland:					
Hagerstown ...	gwi., ll.	25	electrolysis	no	.....
Massachusetts:					
Andover	ll.	.....	.....	....	pressure pumps
Arlington	cl.	.....	.....	very little	tubing pipes
Athol	gwi.	15	rust	yes	by blowing out service toward main against pressure with tissue paper plug
Belmont	wl., cl., ll., g.	.....	rust	In g.	Staples spudging mach.
Boston	l., cl. (e)	.....	.....	at connection	blowing paper pellet through w. force pump
Brockton	g., cl., cl.	g., cl.-20-30	g. rust, ci. elect. or breakage	very little	forced out with pump under pressure
Brookline	cl., wl.	cl.-45+	rust	no	.....
Cambridge	ll.	12	corrosion of old g.	yes	Staples cleaning rods
Clinton	s. cl., wi. cl. & ll.	40+	rust	some	flexible rod, dig
Concord	cl., l.	wl., 15-18 cl., 25	wi. rust	....	.....
Danvers	cl.	10-40	rust	no	.....
Dedham	cl.	32+	.....	....	.....
Easthampton ..	wi.	40	rust	no	.....
Everett	l.	35	corrosion	some at corp. cock	force pump w. wad of paper—sometimes dig up corp. cock
Fairhaven	l., g.	g.-10	rust on l.	yes	dig up and scrape out rust
Fitchburg	cl., wl.	50+	rust	some	run in small pipe
Framingham ...	wi. up to 2" 3" and up-cl.	ci., 2-20 wl.—25+	elect., rust	no	.....
Haverhill	l.	l.-50+	rust, elect.	rarely	.....
Hingham	gwi., cl.	wi.-25	corrosion inside	yes	by running wire through and by pressure pump
Hudson	cl., gwl.	20-40	rust	some	wire out
Lawrence	l.	25-30	rust at coup. or curb	....	pressure
Lenox	s.	30+	rust	no	.....
Maynard	cl., wl.	30+	.....	yes	with wire put in service from cellar
Medford	cl., cl.	25+	rust at connections	yes	force pump and wiring
Milford	gwi., cl.	wi.-25 cl.-40+	rust	some	force paper plug through
Montague	g.	.....	electrolysis	no	.....
Needham	cl. and ll.	32+	.....	in l org.	drill
New Bedford ..	l. up to 1" cl.-over 1"	wi., 10-15 l., 55+	rust in wi.	very little	forcing wad of paper through
Newburyport ..	wi., cl.	.....	rust at joints	some	.....
N. Attleboro ...	l.-¾"	30+	rust. in wl. and joint of l.	not with l.	.....
Norwood	wi., cl.	20	rust	very little	rods, force pump, etc.
Oxford	g.	.....	.....	no	.....
Peabody	ll., formerly wi.	wi.-15-30	rust and sediment from water	yes	renew
Reading	wi.	20	wall settling and elect.	yes, cl.	blow out
Springfield	wi. and ll.	20-wi.	elect and rust	yes	Staples cleaner
Swampscott ...	wi., cl.	10	rust	yes	pumping and rods
Taunton	cl., wl.	30-40	acidity of soil	some	force pump or wiring out
Waltham	cl., wi.	20-25	rust	very little	block tin forced through with water on; bad cases, force pump with water on
Wareham	brass	15	rust in form of scale	....	renewal
Wellesley	wi., l., ll., cl., ci.	.....	wl.-rust	....	renew
Westboro	wi.	18	rust	no	.....
Winthrop	l.; g. in past	g.-8-10	rust	....	force pump; relay with l.
Wrentham	wl.	15+	.....	no	.....

*For footnotes see page 859.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
Michigan:					
Alma	l. under pav; wl. and s. — wi.	wi. and gs.-20	rust	no	.....
Ann Arbor		20	rust	on old serv.	force pump, rods
Battle Creek	See Note (f)	g., 20-40 ci., 100-200	elect.; little rust	none	.....
Bay City	l.	.....	.....	no	.....
Big Rapids	wi.	.....	.....	....	.....
Crystal Falls	g.	.....	sometimes pipes freeze and split	sometimes	force pumps
Detroit	l. and ci.	.....	.....	....	.....
Dowagiac	wi. and l.	wl.-30	rust	rarely	with wire
Escanaba	wl. g. with l. on gooseneck	33+	.....	no	.....
Gladstone	g.	20	rust in joints	no	.....
Greenville	g.-serv to curbs	30+	.....	no	.....
Highland Park	l.	.....	.....	no	.....
Holland	gs.	20+	rust	no	.....
Ironwood	g.	.....	.....	no	.....
Marine City	l. and wl.	i., 20-25	rust on outside of pipe	some	force pump back pres're
Marquette	g.	25	rust., elect.	no	.....
Marshall	s.	18	elect. oxidizes l., so only use goosenecks at main	yes	blowing out with air pressure
Menominee	s.	.....	rust	no	.....
Mt. Clemens	l.	25	electrolysis	no	.....
Mt. Pleasant	wi.	15-30	rust	yes	with cable and water
Niles	l.	.....	rust	no	.....
Onaway	s. and wl.	.....	rust	no	.....
Rochester	g., wi., s.	g., wi.-27+	electrolysis	no	.....
Saginaw	l.	40	electrolysis	yes	force back with 150 lb. pump
St. Clair	l. and g.	.....	electrolysis	yes	force pump
St. Louis	l. and s.	.....	.....	yes	air pressure
South Haven	s., wl.	.....	rust	no	.....
Stufgis	l.	30	.....	no	.....
Three Rivers	l.	.....	rust	yes	using high pressure of compressed air and blowing from meter to mains
Traverse City	gwl.	25-30	rust	no	.....
Wakefield	l.	25	.....	no	.....
Minnesota:					
Aurora	gl. and gooseneck	.....	.....	yes	wire tape or steam
Brainerd	g.	15-18	rust	no	Edison diaphragm pump
Cloquet	g.	.....	.....	no	.....
Crookston	wi. and l.	wi., 15	rust	no	.....
Duluth	l.	.....	electrolysis	little	force pump
Hastings	g.	.....	rust	yes	new goose necks and corp cocks
Hutchinson	wi. and l.	wi., 10	elect., rust	no	.....
Lake City	wi. and l.	wi., 14	rust	....	flushing
Little Falls	.....	.....	rust	no	.....
Luverne	l. and wl.	wi., 16	rust	yes	blow out; renew
Minneapolis	l.	.....	.....	no	.....
Northfield	l.	.....	.....	no	.....
Pipestone	l.	gi., 20; l., 10+	rust on g.	no	.....
St. Cloud	g.	.....	.....	no	.....
St. Paul	l. up to 1½"; ci. 2" and over	30	elect., corrosion	no	force pump used occasionally
Staples	gwl.	.....	.....	no	.....
Stillwater	wi.	20-25	electrolysis	no	.....
Two Harbors	l.	i. formerly used, 15	iron in red clay gave out first	no	.....
Waseco	l.	gi., 12	rust	yes	.....
W. Minneapolis	wl. and l.	.....	.....	....	.....
Worthington	ci. and wl.	wl., 5-10	rust	yes	.....
Mississippi:					
Canton	gs.	15-20	rust	no	pump w. comp. air
Clarksdale	wl. and l.	.....	.....	no	.....
Greenville	wl. and l.	wi., 10-20	rust	no	.....
Greenwood	l. and l.	l., 2-10	rust	no	.....
Grenada	wi. and l.	.....	.....	no	.....
Jackson	l. under pav.; g. no pav.	g., 12	rust	some	rod out or by comp air
Laurel	l. under pav.; others s	s., 15	elect. and rust, s.	no	.....
Meridian	wi. and l.	wl., 15	rust	some	renew pipes
New Albany	wi.	12	rust	no	.....
Winona	wl., l., cl.	.....	.....	no	.....
Missouri:					
Butler	wl., l.	.....	rust	not much	.....
Hannibal	l.	.....	.....	....	.....
Jefferson City	l., main to curb g., to house	wi., 20-40	rust	no	.....
Lebanon	ci. and wl.	cl., 30; wl., 12-25	.....	no	.....
Liberty	s. or wi.	.....	electrolysis	no	.....
Macon	l. and l.	.....	rust on l.	....	.....
Marceline	g. wi.	6	rust	no	.....
St. Louis	l. to curb	.....	electrolysis	....	force pump
Trenton	l. and wl.	10-l.	rust	no	.....
Webster Groves	l.	.....	electrolysis	no	.....
Montana:					
Anaconda	g. l. connection	10-30	rust		
Billings	l., 1½" ci., larger	g-13	g., alkali and acids	some old	renew
Glendive	l.	s. and wi.-15	chemical in soil	no	.....
Great Falls	g. in past; new l.	g., 1-10	elect., chem. reaction of soil	no	.....
Missoula	g.	30+	rust, freezing	little	force pump

(*For footnotes, see page 359*)

Table III—Water Works Services

Municipality.	Private (P.) or municipal (M.) plant.	Services laid preparatory to paving, before needed for use. Are they required by city?	Kind of pipe specified.	Depth specified.	Trouble experienced with them after laying.
Alabama:					
Bessemer	P.	yes	½" g.	2 ft.	none
Gadsden	M.	yes	ll.	18 in.	none
Jasper	P.	no	none	...	.....
Mobile	M.	yes	g.	at least 2 ft.	none
Montgomery	M.	yes	l.	2 ft.	none
Opelika	M.	yes	gl., ll.	2 ft.	none
Sheffield	P.	yes	l.	3 ft.	none
Talladega	M.	yes	g.	2 ft.	none
Arizona:					
Phoenix	M.	yes	...	...	breakage when rolling for pav.
Arkansas:					
Arkadelphia	M.	lay to curb when required	¾ g., stop cock and cut-off box	12 in.	corroding
Batesville	M.	no	...	18 in.	.....
Ft. Smith	M.	...	...	2-2½ ft.	.....
Harrison	M.	no pav.	...	2½ ft.	.....
Jonesboro	M.	yes	¾" wi., g.	18 in.	none
Mena	M.	...	¾" g.	18 in.	none
Pine Bluff	P.	yes	g.	3½-4 in.	.....
California:					
Long Beach	...	no	...	2 ft.	corrosion
Pasadena	M.	yes	¾" for 50 ft. lot	2 ft.	none
Pomona	P.	yes	regular	30 in.	some too small for class of consumer
Riverside	M.	no	¾" wi.	30 in.	none
San Jose	P.	no	...	18 in.	.....
Santa Barbara	M.	yes	...	2 ft.	.....
Santa Cruz	M.	no	...	2 ft.	.....
Colorado:					
Boulder	M.	yes	wi.	3 ft.	none
Colo. Springs	M.	no	...	4 ft. 6 in.	none
Ft. Collins	M.	yes	wi.	4 ft.	none
Greeley	M.	no	l.	5 ft.	none
Longmont	M.	yes	l.	4 ft.	none
Rocky Ford	...	yes	l.	3 ft.	none
Connecticut:					
Ansonia	P.	no	...	...	.....
Bridgeport	P.	no	none	4½ ft.	.....
Danielson	P.	no	...	...	.....
Derby	P.	request	...	4 ft. 6 in.	.....
Middletown	M.	usually done	...	4½-5 ft.	.....
Norwich	M.	no	...	...	.....
Putnam	M.	none	...	4 ft. 9 in.	some settling
Torrington	P.	no	...	...	.....
Wallingford	M.	yes	1" gwi.	4" in clay 5" in sand	none
Willimantic	M.	yes	l.	4½ ft.	none
Florida:					
Gainesville	M.	yes	l., wi.	2 ft.	leaking joint on cut-off
Jacksonville	M.	yes	g.	18-24 in.	clogging up corp. cocks
Key West	M.	...	l., flushing	12 in.	.....
Lake City	M.	no	...	...	.....
Live Oak	...	yes	¾" g.	3½ ft.	none

Municipality.	Private (P.) or municipal (M.) plant.	Services laid preparatory to paving, before needed for use. Are they required by city?	Kind of pipe specified.	Depth specified.	Trouble experienced with them after laying.
Indiana—Continued					
Elkhart	P.	yes	l.	5 ft.	freezing of services not in use
Elwood	P.	no	none	3 ft.	none
Ft. Wayne	M.	yes	...	...	.....
Gas City	M.	no	¾"-2" g.; l. connec.	36 in.	they pit, cause leakage
Greenfield	M.	usually	wi.	5 ft.	none but rust
Greensburg	P.	no	none	3 ft.	.....
Hobart	M.	yes	l.	5½ ft.	none
Huntington	M.	yes	⅝" l.	4 ft.	none
Indianapolis	P.	yes	l.	4½ ft.	none
Jasper	M.	no	none	...	none
Lafayette	M.	yes	l.	4½ ft.	none
La Porte	M.	yes	l.	5½ ft.	practically none
Lebanon	M.	yes	l.	3 ft.	none
Linton	M.	no	...	3 ft.	subsoil pitting
Marion	M.	no	l.	40 in.-5 ft.	elect. and wiped joints
Martinsville	...	yes	g.	42 in.	none
Mich. City	M.	no	l., wi.	4½ ft.	none
Mishawaka	M.	yes	lead	5 ft.	none
New Albany	P.	no	½" gwi.	2 ft. 6 in.	practically none
New Castle	M.	yes	reg. serv.	40 in.	none
South Bend	M.	yes	l.	5 ft.	practically none
Tell City	M.	yes	¾" gs.	4 ft.	none
Terre Haute	P.	yes	l.	4 ft. 6 in.	.....
Tipton	M.	yes	g. and l.	3½-4 ft.	none
Union City	M.	no	l.	3-3½ ft.	none
Vincennes	P.	yes	½"-¾"	3 ft.	none
Whiting	M.	no	...	...	.....
Iowa:					
Algona	M.	yes	l.	5½ ft.	sometimes have to lower st. to grade
Boone	M.	yes	l.	5 ft.	freezing
Burlington	P.	...	...	5 ft.	l. failed in wiped joints; also freezing
Cedar Rapids	M.	yes	l.	5½ ft.	not much
Council Bluffs	M.	yes	l.	5 ft.	practically none
Davenport	P.	yes	l.	6 ft.	breaking off due to settlement or violence
Eldora	M.	yes	double strength pipe	5 ft.	very little
Ft Dodge	M.	no	l.	5½ ft.	none
Harlan	M.	yes	l. and l.	5 ft.	very little
Independence	M.	no	l.	5½-6 ft.	clogging
Iowa Falls	M.	yes	l.	5 ft.	.....
Maquoketa	M.	yes	wi., l.	5 ft.	wasting of material due to soil
Marion	P.	yes	l.	5½ ft.	none
Mason City	M.	yes	l.	6 ft.	none
Muscatine	M.	yes	l.	6 ft.	.....
New Hampton	M.	yes	l.	5½ ft.	seldom any
Sac City	M.	yes	standard	5 ft.	none
Sioux City	M.	yes	l.	5½ ft.	.....
Storm Lake	M.	yes	none	4 ft.	none
Valley Jct.	...	yes	g.	4 ft.	none
Washington	M.	yes	l	4½-5 ft.	none
Kansas:					
Atchison	P.	no	...	3½ ft.	.....
Chanute	M.	yes	l.	2½ ft.	none
Coffeyville	M.	yes	l.	20 in. +	none
Eureka	M.	no	...	...	.....

Georgia:					
Athens	M.	yes	g.	30 in.	none
Atlanta	M.	yes	wi.	2 ft.	trouble usual to wi. pipes
Bainbridge	M.	yes	...	2 ft.	none
Covington	M.	none	...	...	.....
East Point	M.	yes	¾-1 in.	18 in.	none
Griffin	M.	yes	O. D. g.	2 ft.	none
La Grange	M.	yes	ll., wi.	3 ft.	none
Marietta	M.	yes	g.	2 ft	none
Moultrie	M.	yes	¾", 75' lots ½", 50' lots	18 in.	none
Pelham	M.	none	...	24 in.	.....
Rome	M.	yes	1" s.	2 ft.	none
Savannah	M.	yes	...	2-6 ft.	none
Thomasville	M.	yes	gs.	...	none
Idaho:					
Boise	P.	no	...	4 ft.	.....
Illinois:					
Abingdon	M.	yes	l.	4 ft.	none
Bloomington	M.	yes	l., ci.	4½ ft.	breaking at joint, leaking gasket
Bushnell	M.	no	l.	3 ft.	none
Centralia	M.	yes	l.	30 in.	none
Chicago Heights	...	some sections	l.	3 ft. 6 in.	very little
Christopher	M.	yes	l.	30 in.	none
Decatur	M.	no	g.	4 ft.	none
Depue	M.	no	...	...	.....
Downers Grove	M.	yes	...	4-6 ft.	none
Effingham	P.	no	l.	3½ ft.	none
Elmhurst	M.	yes	l.	5 ft. 6 in.	none
Freeport	P.	no	...	...	.....
Geneva	M.	yes	l.	5 ft.	none
Harrisburg	P.	no	l.	18-24 in.	.....
Harvard	M.	yes	l.	5½ ft.	none
Harvey	P.	no	l.	4 ft. 6 in.	curb cocks get corroded
Lake Forest	M.	no	...	5½ ft.	.....
Lawrenceville	P.	no	...	36 in.	none
Lincoln	P.	no	...	3¼ ft.	practically none
Mattoon	M.	yes	l.	3 ft.	none
Moline	M.	no	l.	6 ft.	none
Morrison	M.	yes	gwi.	4½-5 ft.	none
Naperville	M.	yes	l.	5 ft.	.....
Peoria	P.	yes	l.	5 ft.	a few leaks
Princeton	M.	no	...	...	.....
Quincy	M.	yes	l., ci.	4 ft.	none
Riverside	M.	yes	l.	5 ft.	with wiped joints
Rock Island	M.	...	l.	6 ft.	none
Rockford	M.	advocat'd	¾" single, 1" double service	6 ft.	none
St. Charles	M.	yes	l.	5 ft.	none
Springfield	M.	request	...	42 in.	none
Streator	P.	no	...	...	.....
Vandalia	M.	no	...	...	.....
Waukegan	M.	no	l.	5 ft.	none
W. Chicago	M.	yes	l.	4½ ft.	.....
Indiana:					
Auburn	M.	yes	l.	4½ ft.	none
Aurora	P.	yes	l.	3-4 ft.	none
Bedford	M.	yes	⅝"-¾"	30 in.	none
Bluffton	M.	yes	l.	3 ft.	none
Brazil	M.	no	...	4 ft.	when not in use clog
Columbia City	M.	yes	l.	3½ ft.	none
Crawfordsville	P.	yes	¾"	4 ft.	little
Crown Point	M.	...	l.	4 ft.	settlement of trenches, careless bedding
Decatur	M.	yes	l.	3½-4 ft.	none
E. Chicago	P.	yes	l. and l.	4½ ft.	none
Fort Scott	M.	no	l.	3 ft.	.....
Fredonia	M.	no	...	30 in.	.....
Galena	M.	yes	g. and l.	2 ft.	none
Girard	M.	yes	l.	2 ft.	none
Great Bend	P.	nn	l.	30 in.	none
Hays	M.	yes	wi. or l.	3 ft.	none
Hutchinson	P.	...	g. wi.	36 in.	elect. mostly
Independence	...	...	wi.	2½ ft.	bad weld, galvanized
Lyons	M.	yes	lead flanged union	30 in.	none in 6 yrs.
McPherson	M.	no	...	3-4 ft.	.....
Olathe	M.	yes	l.	18 in.-2 ft.	none
Osawatomie	M.	no	...	30 in.	none
Pittsburg	M.	no	...	30 in.	none
Salina	P.	yes	¾" l.	3½-4 ft.	none
Topeka	M.	no	none	4 ft.	leak and stoppage
Kentucky:					
Ashland	M.	no	...	...	.....
Catlettsburg	P.	no	none	no specifications	.....
Covington	M.	no	⅝	3½ ft.	.....
Hazard	M.	yes	¾" g.	18 in.	none
Lexington	P.	generally	l.	2½ ft.	none
Louisville	M.	yes	none	3 ft.	very little
Morganfield	M.	yes	l.	16 in.	very few
Providence	M.	yes	l.	2 ft.	none
Louisiana:					
Baton Rouge	P.	yes	l.	30 in.	very few give trouble
Kentwood	M.	no pav.	...	...	.....
Leesville	P.	no	g.	18 in.	.....
Rayne	M.	no	...	18-24 in.	.....
Maine:					
Augusta	M.(c)	no	ll.	5½ ft.	.....
Bath	M.	no	...	4½-5 ft.	.....
Eastport	P.	no pav.	...	...	.....
Lewiston	M.	...	...	...	.....
Portland	M.	no	...	5 ft.	.....
Maryland:					
Chestertown	M.	no	...	30 in.	.....
Hagerstown	M.	no	none	3 ft	no
Massachusetts:					
Andover	M.	yes	ll.	5 ft.	none
Arlington	M.	yes	cl.	5 ft.	occasional frozen service
Athol	M.	no	...	5 ft.	.....
Belmont	M.	no	...	...	.....
Boston	M.	yes	l., ci.	5½ ft.	.....
Brockton	M.	no	...	...	.....
Brookline	M.	no	...	5½ ft.	.....
Cambridge	M.	...	ll.	4½ ft.	.....
Clinton	M.	...	...	5 ft.	.....
Concord	M.	no	...	...	.....
Danvers	M.	no	...	4½ ft.	.....
Dedham	P.	no	...	...	.....
Easthampton	M.	yes	g.	5 ft.	none
Everett	M.	...	l.	5 ft.	practically none
Fairhaven	P.	no	...	4½ ft.	none
Fitchburg	M.	no	...	6 ft.	.....
Framingham	M.	yes	wi.	5 ft.	none
Haverhill	M.	no	...	...	.....
Hingham	P.	...	...	...	.....
Hudson	M.	yes	cl. g. wi.	6 ft.	none
Lawrence	M.	no	l.	2½-5 ft.	.....
Lenox	P.	no	...	...	.....
Maynard	M.	no	...	...	.....
Medford	M.	no	...	...	.....
Milford	P.	no	...	...	.....
Montague	P.	no	...	...	.....
Needham	M.	no	...	...	.....

(For footnotes, see page 359)

Table III—Water Work Services—Continued

Municipality.	Private (P.) or municipal (M.) plant.	Services laid preparatory to paving, before needed for use.			
		Are they required by city?	Kind of pips specified.	Depth specified.	Trouble experienced with them after laying.
Massachusetts—Continued					
New Bedford ...	M.	in few cases	l.	4 ft.	often in wrong location for bldg. when built
Newburyport ..	M.	yes	wl. cl.	5 ft.	.....
No. Attlsboro...	M.	no	...	4½ ft.	none
Norwood	M.	no	...	...	.....
Oxford	M.	no	...	...	frost
Peabody	M.	yes	ll.	4½ ft.	none
Reading	M.	yes	¾" g.	4½ ft.	none
Springfield	M.	no	...	6 ft.	usually wrong size & location for bldg.; also may leak
Swampscott ...	M.	yes	cl.	4-6 ft.	none
Taunton	M.	no	...	...	.....
Waltham	M.	yes	1" cl.	5 ft.	none
Wareham	M.	no pav.	...	4 ft.	.....
Wellesley	M.	no	...	5 ft.	none
Westboro	M.	no	none	...	.....
Winthrop	M.	yes	...	5 ft.	none
Wrentham	M.	no	...	...	.....
Michigan:					
Alma	M.	yes	l.	4 ft. 6 in.	none
Ann Arbor	...	yes	none	below frost line	leaks from rusting
Battle Creek ...	M.	yes	{1"-l. {more-g.	5½ ft.	very little
Bay City	M.	yes	l.	4 ft.	some frozen
Big Rapids	...	no	...	5½-6 ft.	none
Crystal Falls ..	M.	yes	...	6 ft.	some froze and burst
Detroit	M.	to limited extent	l. and cl.	5 ft.-paved sts; 6 unpav.	.....
Dowagiac	M.	yes	l.	4 ft.	practically none
Escanaba	M.	yes	wl. g.	6 ft.	none
Gladstone	M.	yes	l.	5 ft.	none
Greenville	M.	yes	g.	5-6 ft.	none
Highland Park..	M.	yes	l.	5 ft.	.....
Holland	M.	yes	gs.	4 ft.	nons
Ironwood	M.	no	...	...	.....
Marine City ...	...	yes	l.	4 ft.	none
Marquette	M.	no	...	6 ft.	.....
Marshall	M.	yes	g.	5 ft. 3 in.	.....
Menominee	M.	yes	¾"	5 ft.	none
Mt. Clemens	M.	yes	l.	5 ft.	none
Mt. Pleasant ...	M.	no	...	4½ ft.	.....
Niles	M.	yes	l.	5 ft.	none
Onaway	...	yes	wl. l. necks	4½ ft.	freezing only
Rochester	M.	yes	g.	4½ ft.	none
Saginaw	M.	yes	l.	5 ft.	none
St. Clair	M.	no	...	4 ft.	.....
St. Louis	M.	no	none	...	.....
South Haven ..	M.	yes	l.	4-5 ft.	freezing in soms cases
Sturgis	M.	yes	⅝" l	5 ft.	nons
Three Rivers ..	M.	yes	¾" l. with curb cocks and cut-off box	5 ft.	none
Traverse City ..	M.	no	...	4½ ft.	none
Wakefield	M.	yes	l.	5 ft.	none
Minnesota:					
Aurora	M.	yes	l. gooseneck; Minneapolis curb cocks	7 ft.	valve boxes raised from curb cocks by frost

Municipality.	Private (P.) or municipal (M.) plant.	Services laid preparatory to paving, before needed for use.			
		Are they required by city?	Kind of pips specified.	Depth specified.	Trouble experienced with them after laying.
Nebraska—Continued					
Gering	M.	yes	¾" pipe, stop and waste, curl cock, gooseneck	5½ ft.	leakage; losing covers and filling with dirt, etc.
Hastings	M.	yes	l.	5 ft.	none
Lincoln	M.	occasionally	...	4 ft.	none
McCook	M.	yes	l.	5 ft.	none
North Platte....	M.	yes	l.	3½-4 ft.	wiped joints leak
Schuyler	M.	no pav.	...	...	.....
Sidney	M.	yes	l.	4 ft.	none
University Place	M.	yes	l.	4 ft. 6 in.	very little
New Hampshire:					
Berlin	P.	no	...	...	.....
Claremont	...	no	...	...	.....
Concord	M.	no	...	5½ ft.	.....
Dover	M.	no	...	5 ft.	very little
Keene	M.	yes	brass pipe	5½ ft.	none
Lebanon	M.	no	...	...	seldom trouble if properly laid
Pembroke	M.	no pav.	...	4 ft.	.....
Portsmouth	M.	no	...	4 ft.	.....
New Jersey:					
Bound Brook...	P.	no	...	3½-4 ft.	freeze ups occasionally
Bridgeton	M.	yes	l.	3½ ft.	none
Dunellen	P.	no	wl.	3 ft. 6 in.	none
Freehold	M.	yes	wl.	4 ft.	none
Hawthorne	M.	yes	none	4 ft.	none
Hightstown	M.	yes	¾" and 1"	3½ ft.	none
Milltown	M.	request	none	3 ft. 6 in. to 4 ft.	none
Nutley	M.	yes	same as that used	3 ft. 6 in.	.....
Phillipsburg ...	P.	no	none	4 ft.	.....
Ridgewood	M.	yes	ll. g.	4 ft.	none
Rockaway	M.	yes	⅝" corp. top, ¾" pipe	4 ft.	none
New Mexico:					
Silver City.....	P.	no	nons	2 ft.	none
New York:					
Albany	M.	yes	l.	5 ft.	occasional stoppage
Amityville	P.	no	...	...	.....
Auburn	M.	yes	¾"	4 ft.	none
Avon	M.	no	g.	4 ft.	.....
Babylon	P.	yes	g.	3 ft. 6 in.	none
Baldwinsville ..	M.	yes	wl.	4 ft.	none
Brockport	M.	yes	wl.	3½ ft.	none
Buffalo	M.	yes	l.	5-6 ft.	small amt. of service leaks
Canastota	M.	yes	½" l.	4 ft.	breaks in wiped joints
Catskill	M.	no	...	4 ft. 6 in.	general freezing
Clyde	P.	no	...	...	.....
Corning	M.	yes	...	5 ft.	.....
Cortland	M.	yes	1" wl.	5 ft.	none
East Aurora....	M.	yes	none	4 ft.	none
Elmira	M.	yes	l.	5½ ft.	none
Fairport	M.	yes	l.	4 ft.	none
Fort Plain.....	M.	yes	¾" g.	5 ft. 6 in.	bad conn. at times
Frankfort	M.	yes	l.	4½ ft.	none
Freeport	M.	no	...	...	.....

Brainerd	M.	yes	g.	8 ft.	none
Cloquet	M.	no	...	7 ft.	some with frost
Crookston	P.	no	none	7½ ft.	.....
Duluth	...	occasionally	l.	7½ ft.	freeze if not in use
Hastings	M.	yes	g.	7 ft.	none
Hutchinson	M.	no	...	6 ft.	.....
Lake City	M.	yes	l. or g.	6½ ft.	frost if no snow
Little Falls	P.	no	...	...	.....
Luverne	M.	not outside of pav. dist.	wl.	6-8 ft.	clogging
Minneapolis ...	M.	yes	l. with stop and box	9 ft.	due to local conditions
Northfield	M.	yes	l.	7½ ft.	none
Pipestone	M.	yes	l.	6½ ft.	lead connections
St. Cloud	...	yes	g.	7 ft.	none
St. Paul	...	yes	l., ci.	8 ft.	leaks in rare instances because of poor workmanship or defective materials
Staples	M.	acc. to judgment	g.	7½ ft.	none
Stillwater	M.	yes	wl.	7 ft.	none
Two Harbors ..	M.	yes	l.	5 ft.	none
Waseo	...	no	l.	5 ft.	none with lead so far
W. Minneapolis.	M.	yes	l.	7 ft. 6 in.	none
Worthington ...	M.	yes	2" ci.	5½-6 ft.	none
Mississippi:					
Canton	M.	yes	l.	24-30 in.	none
Clarksdale	M.	yes	l.	2 ft.	none
Greenville	M.	yes	l.	15-20 in.	wiped joints
Greenwood	M.	yes	l.	30 in.	very little
Grenada	M.	yes	l.	30 in.	none
Jackson	M.	yes	l. or ci.	24 in.	none except where sts. are rolled for pav.
Laurel	M.	yes	...	to come under pav.	.....
Meridian	M.	yes	l.	2 ft.	none
New Albany ...	...	yes	g.	30 in.	none
Winona	M.	yes	l.	12 in.	none
Missouri:					
Butler	M.	...	...	...	.....
Hannibal	M.	no	...	4 ft.	.....
Jefferson City...	P.	no	...	3 ft. 6 in.	only where faulty workmanship
Lebanon	M.	no	...	2 ft.	frost; breaks from rust in small wi. pipes
Liberty	M.	yes	...	2½ ft.	.....
Macon	M.	no	...	...	.....
Marceline	M.	no	...	3 ft.	.....
St. Louis.....	M.	no	...	...	.....
Trenton	M.	yes	l.	below freezing point	locating
Webster Groves.	both (g)	no	...	...	.....
Montana:					
Anaconda	P.	yes	g, l. connection	6 ft.	none
Billings	M.	yes	l. and ci.	5½ ft.	none
Glendive	M.	expect to	l.	6½ ft.	none
Great Falls....	M.	yes	l.	5 ft.	.....
Missoula	P.	no	...	6 ft.	.....
Nebraska:					
Aurora	M.	no	¾" g. or l.	5 ft.	freezing when sts. graded; giving out
Chadron	M.	yes	l.	4 ft.	none
Fairbury	M.	yes	3½ l.	5 ft.	none
Fremont	M.	yes	...	4½ ft.	.....
Geneva	M.	yes	l.	4 ft.	none
Glen Falls	M.	yes	¾", ½" con.	4-6 ft.	none
Gloversville	M.	yes	l.	4½-6 ft.	freezing and bursting. Corrosion at corp. cock if not used
Hamburg	P.	no	...	4-4½ ft.	none
Hoosick Falls..	...	...	g.	...	.....
Hudson	M.	yes	l.	6 ft.	sometimes freezing
Hudson Falls...	P.	yes	...	5 ft.	none
Ithaca	M.	yes	l.	5 ft.	.....
Jamestown	M.	yes	wl.	4 ft. 6 in.	shorter life than active service
Le Roy.....	M.	no	wl.	5 ft.	.....
Lyons	M.	no	...	4½ ft.	few affected by frost
Middletown	M.	yes	...	4½ ft.	.....
Mohawk	M.	yes	g.	4 ft.	none
Mount Morris...	M.	no	brass or l.	4 ft.	none
Mount Vernon..	P.	no	l.	3½ ft.	none
Newark	M.	yes	l.	4½ ft.	none
New York.....	M.	no	...	...	.....
Norwich	P.	yes	...	5 ft.	none
Nyack	M.	yes	¾"-1" g.	3½-4 ft.	rust holes
Ogdensburg	M.	yes	g. wl.	5 ft. 6 in.	none
Olean	M.	yes	l.	3½-4 ft.	none
Oneonta	P.	yes	l.	5 ft.	occasional leak
Ossining	M.	no	l.	4½ ft.	had to dig up at main and curb
Oswego	M.	yes	l.	4 ft.	none
Perry	M.	yes	g. wl.	4 ft.	none
Rochester	M.	yes	l., ll.	4½ ft.	.....
Salamanca	M.	no	...	4 ft.	.....
Saratoga Sprgs.	M.	yes	g.	below frost zone	mostly from service lines laid before corp. cocks were used
Scotia	M.	yes	⅝" l.	5 ft.	none
Seneca Falls....	P.	yes	g.	4½ ft.	giving out of wiped joints on gooseneck
Sidney	M.	yes	l.	5 ft.	freezing, cracking of joints
Syracuse	M.	yes	l.	5 ft.	more or less frozen services
Tarrytown	M.	in some casee	l.	3 ft. 6 in.	none
Wappingers Falls	M.	yes	l.	4 ft.	none
Waterford	M.	yes	none	5 ft.	rust
Waterloo	P.	yes	wl.	4 ft.	elect. only
Watertown	M.	yes	g. wl.	5 ft.	none
Watervliet	M.	yes	l.	5 ft.	none
Wellsville	M.	generally	wl. g.	5 ft.	none
Westfield	M.	no	...	4½ ft.	elect.
Yonkers	M.	no	...	4 ft.	very little
North Carolina:					
Canton	M.	yes	g. l. goosenecks	4 ft.	none
Greensboro	M.	yes	wl.	18 in.	.....
High Point.....	M.	yes	water tap without meter	2 ft.	.....
Lenoir	M.	yes	none	2 ft.	none
Monroe	M.	yes	wl. l. goosenecks	2 ft.	scarcely any
Morehead City..	M.	no	...	...	.....

(a) Ten years in clay and hardpan, 20 years in sandy loam; (b) g. until 1 year ago, now heavy lead for all services in street to curb box, when galv pipe may be used; (c) quasi municipal; (d) ll. to street line where road is macadam; (e) principally lead, now introducing ci.; (f) lead main to near curb, up to 1"; 2" g., 4" up ci. curb to house ¾" to 2" g.; (g) municipal distribution system—private supply; (b) lead pipe across streets and alleys; galv. iron, lot line into building; (j) company owns mains only. Services financed and maintained by property owners.

Recent Legal Decisions

IMPROVEMENT HELD TO DIFFER FROM THAT AUTHORIZED BY ORDINANCE SO THAT ASSESSMENT COULD NOT BE LEVIED.

The authority to make local improvements by special assessment is statutory, and the statute must be followed strictly in order to give the courts jurisdiction to enforce the collection of the assessments. The Illinois Supreme Court holds, City of Chicago v. Jerome, 134 N. E. 92, that a legal and sufficient ordinance lies at the foundation of every valid assessment. Such ordinance must prescribe the nature, character, locality and description of the improvement to be made. If the improvement constructed is substantially different from the improvement authorized to be constructed by the ordinance, property owners cannot be compelled to pay for it by special assessment. Where five lateral sewers, designed to serve a subdivision consisting of 80 acres of land, had been abandoned, this was held to be an entirely different improvement from that described in the original ordinance, and the only way in which that ordinance could be amended was by passing another valid ordinance.

PROPERTY SUBJECT TO PAVING ASSESSMENT HELD NOT RELIEVED SO AS TO MAKE MUNICIPALITY LIABLE.

It is well settled that where a city, after letting a contract for a public improvement to be paid for by assessments on private property to which such property is liable, and after a large part of the expense of making it has been incurred by the contractor, does any acts without the consent of the contractor to release from liability part of the property subject to assessment, and thereby make it impossible for the contractor to collect part of the contract price for his work, the city will be liable to him for the amount thus made uncollectable. But the Indiana Supreme Court holds, City of LaPorte v. Ahlborn, 133 N. E. 874, that when a contract to fill, grade and pave a street was nearly done and after the contract time for completion, a city passed an ordinance requiring a street railway company to locate its tracks along the centre of the street, which ordinance was subsequently repealed, this did not make the city liable for part of the cost of the improvement, on the ground of having relieved the company from the liability.

PROCEDURE IN REFERENDUM FOR PURCHASE OF PUBLIC UTILITY PLANT.

Where a statute authorizes a municipality to require a referendum vote on the question whether it shall acquire, within or without the municipality, a plant for the manufacture of gas, electricity or steam for supplying light, heat and power, or two or all of these, and that the municipality may by resolution require such a referendum, according to which the ballots must be prepared, the resolution must definitely state the character of the plant necessary, and clearly indicate the purpose of the referendum, so that a distinct proposition is presented on which the voter may vote "Yes" or "No." Whether the plant shall be within or without the city, or whether the lighting shall be by gas or electricity, are, under the statute, distinct propositions, on each of which the voter must be given an opportunity to answer "Yes" or "No."—Board of Trade of City of Newark v. City of Newark, New Jersey Supreme Court, 116 Atl. 172.

FIXTURES OF MUNICIPAL PLANT EXEMPT FROM TAXATION.

The Maine Supreme Judicial Court holds, Inhabitants of Whiting v. Inhabitants of Lubec, 115 Atl. 896, that under Maine Laws 1911, c. 120, exempting fixtures used by municipal corporations in supplying water, power, or light, a penstock, or large pipe, through which water runs from the dam to the power house, an electric generator, and other machinery, as well as the transmission lines, are fixtures, and as such exempt from taxation.

SALE OF PUBLIC WORKS BONDS TO CONTRACTORS CONTINGENT ON AWARD OF CONTRACT TO THEM IF LOWEST HELD VALID.

The Texas Court of Civil Appeals holds, Gibson v. Davis, 236 S. W. 202, that the fact that a bid for the purchase of road bonds is contingent upon the award to the bidder of the contract to construct the proposed road is no legal obstacle to the consummation of the sale of the bonds to the bidder, where it is shown that his bid was a sum above the market value of the bonds, and that his bid for the construction of the road was the lowest and best bid obtainable, and not above the sums usually prevailing for such work. In Ogg v. Dies, 176 S. W. 638, a similar case, the court said: "The law does not prohibit a county from selling bonds to contractors for public works for the construction of which the bonds are issued. The (Texas) statute forbids the sale of bonds of this character for less than par value and accrued interest."

EXPEDIENCY OF WATERWORKS AND SEWER IMPROVEMENTS FOR CITY COUNCIL.

In an action by certain taxpayers of the city of Hankinson to enjoin its officers from proceeding further with the construction of certain waterworks and sewer systems, the North Dakota Supreme Court holds, Jones v. City of Hankinson, 186 N. W. 276, that the evidence did not establish fraud of the officers, or the condition alleged, that "usually the engineer has some friend contractor with whom he is dealing, or in whose business he has a direct interest," which prevents him safeguarding the interests of the city. The court said: "It is said that the improvements are too expensive, and are of doubtful value. These, of course, are administrative or legislative, and not judicial, questions. There are few, if any, municipal improvements constructed but that some one questions the necessity or reasonableness thereof. The power to determine these questions is conferred upon the city council. The court may inquire into the acts of the council to ascertain whether they have acted according to law, but the court may not substitute its judgment for the judgment of the city as to the wisdom or expediency of the improvement."

NEWS OF THE SOCIETIES

CALENDAR

May 15-16—FLORIDA ENGINEERING SOCIETY. Daytona, Fla.

May 15-19 — AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 163 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting Washington, D. C.

May 17—UTAH SOCIETY OF ENGINEERS. University Club, Salt Lake City.

May 17-18—LEAGUE OF TEXAS MUNICIPALITIES. Annual convention. Waxahachie, Tex. Secretary, F. M. Stewart, University of Texas, Austin.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE, Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines, Iowa.

June 5-7—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff. 60 State St., Boston, Mass.

June 6-8—CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 1-6—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

LOUISIANA ENGINEERING SOCIETY.

The regular meeting in New Orleans was held Monday, May 8. A paper entitled "The Limitation of Loads on Highways," was presented by Donald A. Du-Plantier. It was resolved by the Louisiana Engineering Society that it approves and endorses the construction of the New Orleans-Hammond Lake Shore Highway, and that it urges the State Highway Commission and all other interested authorities to hasten the financing of the remainder of the estimate cost and proceed with the construction.

NEW YORK STATE CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS.

New York State City Clerks' Association—New York State Fire Chiefs' Association—With Sectional Meetings for Purchasing Agents, Corporation Counsels and City Attorneys, Charity Officials, Assessors, City Engineers, Health Officers, and Comptrollers, City Treasurers and City Chamberlains.

The conference and association headquarters will be at the Nelson House, Poughkeepsie, June 7-8.

June 5—8:00 p. m., joint meeting of officers, advisory committee and bureau council of the conference, headquarters, Nelson House.

June 6—Inspection of bureau exhibit.

Joint session of conference and associations. "The Year's Progress in Municipal Work in New York State," (president's annual address), Hon. William J. Wallin; "Results of the Legislative Work by the Cities," Hon. William S. Hackett; "Increasing Administrative Efficiency," Bureau Council report; "Solving the Cities' Pension Problem," F. B. Holmes; "The Milk Problem in New York State Cities," Dr. Matthias Nichol; "Investigating a City's Increase in Taxation," Hon. Thomas A. Wilson.

Joint session of conference and associations, 7:00 p. m.—"Progress in the Municipal Home Rule Movement," Senator Ward V. Tolbert; "Equalizing the Burden of Taxation," Senator Frederick M. Davenport; "The State and Its Municipalities," 'Governor Nathan L. Miller.

June 7—Symposium: "What Progress Has Your City Administration Made During the Last Year?"; "What Municipal Problems Is Your City Now Endeavoring to Solve?" (The roll of cities will be called and the representative of each will answer the above questions.) "The Automobile Traffic Problem," Robbins B. Stoeckel; "Mt. Vernon's Model Charter," Hon. Edwin W. Fiske; "The Education Problem in New York State Cities."

Joint session of conference and associations, 8:00 p. m.—"How to Solve the Problem of Reforesting Municipal Water Sheds and Parks at the Least Expense," J. R. Simmons; "Results of the Co-operative Work by New Jersey Municipalities," Hon. Charles P. Gillen; "The Human Side of Municipal Government," John F. Hylan.

Joint session of conference and associations, 9:30 a. m.—A summary of the discussions and business transacted at each sectional meeting held on the two previous days will be given in the following order: City engineers, city clerks, corporation counsels, charity officials, assessors, fire chiefs, fiscal officers, health officers, purchasing agents.

Sectional meeting for corporation counsels and city attorneys, June 6—"Service Charge Legislation, Charles A. Van Auken; "The Legal Side of the Proposed Repeal of the State Railway Paving Law," William S. Elder; "Drafting City Ordinances," Ernest Cawcroft; "Court Decisions Affecting Rate Proceedings," John P. O'Brien.

Sectional meeting for city engineers, June 7—"Trolley Tracks in Street Pavements," A. P. Hartmann; "Modern Street Lighting Practice" (illustrated), A. F. Dickerson; "Distinctive Features of Warrenite-Bitulithic Pavements in Comparison with Other Bituminous Pavements, (illustrated) Geo. C. Warren.

Sectional meeting for municipal fiscal officers (comptrollers, city treasurers and city chamberlains), June 7—"Rochester's System of Financing Public Improvements," Joseph C. Wilson; "Methods of Paying Coupon Bonds and Interest," William A. Toohey; "Methods of Control of Revenues from Water Rentals," J. Walter Ackerman; "Defects Revealed by State Examinations," Charles R. Hall.

Sectional meeting for city purchasing agents, June 6—"The Contribution of the Purchasing Agent to Economical Administration," "The Human Element in Centralized Municipal Purchasing and the Personal Qualifications of the Purchasing Agent," "Standardization of Supplies and Procedure," "The Modern Stores Department and the Central Storehouse," "Purchasing in the Open Market vs. Purchasing in the Home City," "Cash Discounts," "Confirmatory Orders," "The Purchasing Agent of Tomorrow," "Purchasing from State Prison Department," "Group Purchasing."

AMERICAN CONSTRUCTION COUNCIL.

Preliminary arrangements were completed in Washington, D. C., May 3, for the organization of the American Construction Council. Secretary of Commerce Hoover will be the chairman of the organization meeting to be held in Pittsburgh, June 19, and Franklin D. Roosevelt, formerly Assistant Secretary of the Navy, will be the president of the organization

The purpose of the Council is to place the construction industry on a high plane of integrity and efficiency and to correlate the efforts toward betterment made by the existing organizations, through a conference association representative of the whole industry and dedicated to the improvement of the service which the construction industry renders to communities, states, and nation.

All branches of the industry are represented in the new body and have been divided into the following groups, each with equal voting power: Architects, engineers, general contractors, sub-contractors, construction labor, material and equipment manufacturers, material and equipment dealers, financial, bond and

real estate interests, public utility construction departments, and the construction divisions of federal, state and municipal governments.

The organizers of the Council are planning to take up a code of ethics for the industry, development of a national building code; a research and statistical bureau; lengthening of the construction season; elimination of waste; standardization and dimensional simplification; development of apprenticeship systems; and encouragement of local study and better understanding of building situations.

AMERICAN RAILWAY ENGINEERING ASSOCIATION

At its recent annual convention the American Railway Engineering Association elected the following officers: President, James L. Campbell; vice-presidents, E. H. Lee and G. J. Ray; directors, D. J. Brumley, Maurice Coburn, H. T. Douglas, Jr., C. E. Lindsay and W. P. Wiltsee; treasurer, G. H. Bremmer; secretary, E. H. Fritch.

ONTARIO GOOD ROADS ASSOCIATION

The Ontario Good Roads Association elected the following officers at its recent annual convention at Toronto: President, W. H. Brown; vice-presidents, John Curry and George S. Henry; and directors, F. A. Senecal, J. E. Jamieson, A. B. Rose, Peter Ray, F. H. Richardson, and W. H. Nugent.

ROCHESTER ENGINEERING SOCIETY

At the April 11 meeting of the Rochester Engineering Society, held at the Powers Hotel, Mr. L. B. Roberts, division engineer, New York Water Power Investigation, gave an illustrated talk on "Maps and Mapping." The subject was well presented, due to the experience of the speaker in topographic mapping with the United States Geological Survey, and the talk was an exceedingly interesting one.

SOCIETY OF INDUSTRIAL ENGINEERS

The national spring convention will be held at the Hotel Statler, Detroit, on April 26-28. There will be addresses on "The Influence of Industrial Engineering Upon the Earnings of Capital and Labor," including how industrial engineering serves (a) industry, (b) the chief, (c) the executive, (d) the sales manager and (e) the factory manager; also its service to (a) labor, (b) finance and (c) the public. There will also be papers and discussions on "The Conservation of Material, of Plant and Equipment and of Labor and the Workman."

INTERNATIONAL ASSOCIATION OF RAILWAYS

The International Association of Railways will hold its Ninth Congress in Rome, Italy, from April 18th to 30th. The Federated American Engineering Societies was asked to secure the appointment of Mr. J. W. Lieb, former president of the American Institute of Electrical Engineers, former vice-president of the American Society of Mechanical Engineers, and during the war, chairman of the Joint Committee on Power and Gas Industries, Council of National Defense. Mr. Lieb will represent the United States, together with Mr. Charles C. McChord, of the Interstate Commerce Commission, General William W. Atterbury, Col. Edward A. Simmons, Mr. David F. Crawford and Mr. Walter F. Schleiter.

PERSONALS

Rhodes, William H., Jr., has accepted the position of maintenance engineer with the Louisiana Highway Commission.

North, Thomas C., borough engineer of DuBois, Pa., has been elected borough engineer and manager of Blairsville, Pa.

Young, D. A., has recently been appointed state engineer of Vermont.

Sheddan, W. E., formerly assistant city engineer of Jacksonville, Fla., has been appointed city engineer to succeed F. M. Edwards, resigned.

Smith, Alva, for fifteen years city engineer of Emporia, Kan., has resigned.

Layle, John W., superintendent of highways at Bridgeburg, Ont., has resigned to accept a similar position at Fort Erie, Ont.

Knight, D. H., of Kokomo, Ind., will succeed William R. Payne, resigned, as city engineer of Frankfort, Ind.

Fregolie, Walfred, has been appointed village engineer of Hibbing, Minn.

Stanley, George C., has been reappointed city engineer of Burlington, Vt.

Kennedy, J. H., has been reappointed superintendent of waterworks of St. Albans, Vt.

Grimes, L. A., has been appointed superintendent of waterworks and sewers of Abilene, Tex.

Fulenwiter, Henry A., of Wilmington, Del., has been appointed town engineer of New Castle, Del.

Lang, Capt. Fred W., assistant city engineer of Concord, N. H., has been appointed city engineer to succeed W. B. Howe, who died April 3.

Hawkins, H. E., city engineer of Eldorado, Kan., has been appointed city manager.

Hummel, R. S., has been appointed chief of the recently established bureau of street paving of the department of public works, Richmond, Va.

Anderson, Benton, has been elected city engineer of Clinton, Ia.

Goebel, Norman J., engineer for the board of water commissioners, Oshawa, Ont., has resigned.

Bodette, George H., formerly city engineer of Toledo, Ohio, died on April 11 at his home, at the age of 70.

HYDRO-ELECTRIC POWER PROJECTS DISCUSSED BY CABINET

The Boston to Washington superpower survey, the Colorado River development and other projects were discussed by President Harding and his cabinet on April 8th, as a means of minimizing the effect of coal strikes in the future and also in relation to the general economic fabric of the country. According to reports the discussion was most thorough, although no definite conclusions were reached. Secretary Hoover submitted the proposition for discussion and it is said that the cabinet intends to continue its study of the project. The superpower survey of the Atlantic seaboard was fostered by the Engineering Council and a very complete report was prepared for Congress by a commission of engineers about a year ago.

EXAMPLES OF NOTABLE ANCIENT AND MODERN CONSTRUCTION.

Comparative examples of notable ancient and modern construction embodying elements of permanency provided for by the use of concrete.

A Notably handsome and artistic booklet, 31 pages, printed on rich heavy paper and illustrated with a large number of half page and full page colored engravings and sumptuously bound in heavy, rich paper covers, text by Philip Koehring, illustrations by William Mark Young, copyrighted, published and distributed by the Koehring Co. The dominant note is the endurance of human achievement with special reference to the part played by concrete in great public structures for two thousand years and showing the wide field and vast opportunities of the modern scientific and mechanical improvement in concrete work.

Interesting and practical outlines illustrated by artistic etchings are given of many diverse ancient and modern structures, including the Aecropolis at Athens, the Bush Terminal in Brooklyn, the Colosseum at Rome, New York Baseball Stadium, Nimes Roman Viaduct and Highways, Tunkhannock Viaduct, Pennsylvania, great arch bridges, Pyramid of Cheops, Black Hawk Monument, and American highways, dams, sewers and buildings and the Koehring Machinery Plant.

AVERAGE COST OF DIFFERENT PAVEMENTS

A recent compilation by the U. S. Bureau of Records, on the cost of various types of road pavement, covers 68 million square yards of paving constructed with Federal aid in all parts of the United States from 1916 to 1921. The following square yard costs of paving are average figures only: Sand-clay, 18c; gravel, 46c; plain and surface-treated macadam, 95c; bituminous macadam, $2.10; bituminous concrete, $2.50; plain cement concrete, $2.57; reinforced cement concrete, $2.74; and brick, $4.10.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

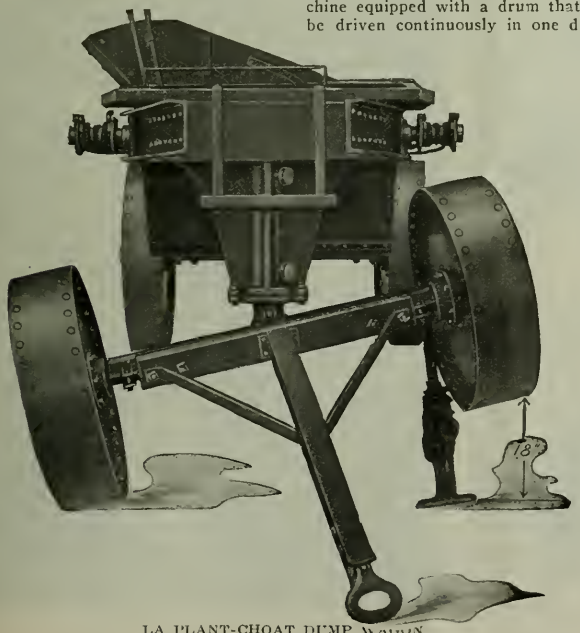
SIX-YARD DUMP WAGON HAULED BY 5-TON TRACTOR.

LA PLANT-CHOAT DUMP WAGONS

The dump wagons produced by the La Plant-Choat Mfg. Co. are made entirely of steel with a special extra strong design intended for service with a tractor and for long endurance under difficult conditions with few or no repairs. Their six-yard capacity makes them suitable for use singly and in pairs with five-ton and ten-ton tractors respectively.

The body and dumping doors are made of reinforced 3/16-inch boiler plate, the main frame is of 8-inch channels not riveted, and the tongue is a 4-inch braced I-beam. The disc wheels are unbreakable and are mounted on roller bearings, lubricated by a grease gun. The front axle has a pivot bearing and the wheels have very wide treads fitting them to carry heavy loads on soft ground. The frame is strong enough to endure the full pull of the 10-h.p. tractor without injury.

One purchaser states that a 5-ton tractor hitched with one 6-yard dump wagon handled an average of 250 yards per day on 500 to 700-foot hauls, with no repair bill and no time lost for wagon breakdowns.



LA PLANT-CHOAT DUMP WAGON.

PORTABLE POWER PLANT

The Pullco Pulling Jack, made by the Puller Manufacturing Company, is an all-steel hand-power machine, combining the principles of both jack and winch, in which pawl and ratchet mechanism is utilized to wind cable on a drum for hoisting and pulling. It is the only hoisting and pulling machine equipped with a drum that can be driven continuously in one direction at high and low speed by a lever moving pendulum fashion.

The Pulling Jack is provided with levers 4½ and 5½ feet long, which drive the drum regardless of the direction of the lever movement, and also with cranks for use when it is desirable to operate the machine as an ordinary winch.

The 5½-foot lever, it is claimed, enables the operator to apply nearly four times the leverage of the crank to the same load. It is possible for one man, using the lever, to hoist five hundred pounds at the rate of 25 feet per minute, and five tons 3½ feet a minute. Direct pull of fifteen tons on a single cable was registered on a testing machine with two men using the 5½-foot lever and exerting their maximum strength. Additional power can be developed by the use of tackle blocks.

PULLCO JACK WINCH
WEIGHT 195 LBS. CAPACITY 50 TONS

The machine weighs 195 pounds is 32 inches long, 18 inches high and 18 inches wide; being mounted on wheels is easily moved from place to place, or can be carried bodily by two men. It is fitted with a hand brake, cable brake and reverse mechanism. Other equipment consists of all-steel cables, tackle blocks, take-up and anchor hook.

The Pulling Jack is recommended for use in pipe laying, pulling test boring pipe, well casing and tubing, cleaning pipe lines, moving machinery, setting and moving boilers, erecting stacks, tanks and windmills, tightening guy lines, erecting aerial tramways, spotting railroad cars, re-railing derailed cars, clearing wreckage, felling walls, bridge building, tunnel construction, unloading freight, moving hoists, concrete mixers, steam shovels,

drilling machines, setting up derricks, binding pile clusters, stay lathing, setting brace piles, pulling sheet piles, moving barges against wind and tide, springing heavy planking in position in barge building, pulling trucks out of the mire, felling trees, pulling stumps and for emergency hoisting and miscellaneous operations.

RUSSELL DRAGLINE

The dragline machine, made by the Russell Grader Mfg. Co., is designed to excavate sand and gravel and convey it from 150 feet to 400 feet to a loading plant at a low cost. It is made in 3 sizes equipped with 45, 30 or 15-h. p. gasoline engine handling ¾, ½ or ⅓ yard buckets and having a capacity of 450, 350 or 250 yards per day, respectively. It is self-filling, self-dumping; can be operated by one man to do the work of several teams; and is recommended for stripping pits, dragging material uphill or downhill, or taking gravel out of creek bed. The operating engine has a front drum for the load cable and a rear drum for the return cable, which passes through a guide block anchored to a dead man. The drums are fitted with tension clutches which are reversed to operate the buckets back and forth. The engines are normally run at 300 to 600 rpm with excavating speeds of buckets at 140, 190, 175 feet per minute and for taking the empty bucket out at 280, 350 and 320 feet per minute for the small, intermediate, and large sizes, respectively.

The bottomless buckets load and unload without the use of manual labor and are automatically dumped by putting the return cable into operation. The engine and drums are mounted on a steel truck and the total weight is 4,600 pounds for the small, 7,075 pounds for the medium and 7,750 pounds for the large machine.

INDUSTRIAL NOTES

Wunsch & TerKuile, Brooklyn, N. Y., is a new firm organized by J. W. Wunsch and C. V. TerKuile, for the sale of materials, handling machinery and industrial and engineering equipment.

William Cramp & Sons Ship & Engine Building Co. have acquired the plant and interests of the Pelton Water Wheel Co., of San Francisco and New York, which will retain its old corporate name and policy.

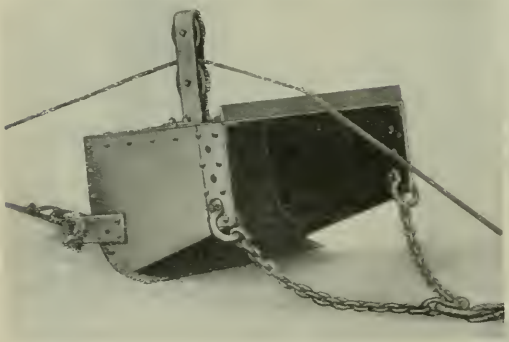
Benham, Webster L., under the firm name of Benham Engineering Co., Consulting Engineers, Suite 512, Gumbel Building, Kansas City, Mo., has taken over all contracts of Benham & Mullergren, and will continue to act as Consulting Engineers on waterworks, sewers and sewage disposal, electric light and power plants, street paving and valuations.

Mullergren, A. L., retires from the Benham Engineering Company, and will engage in private practice, specializing in electric light and power plant engineering and public utilities, Gates Building, Kansas City, Mo.

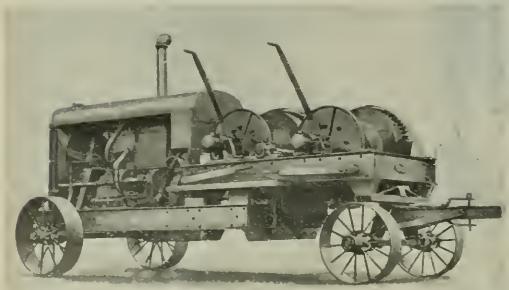
CONSOLIDATION ANNOUNCED

The consolidation is announced of the engineering firms of W. R. Heagler & Sons, of Paragould, Ark., and Hiram Phillips, of St. Louis, Missouri.

Drainage, flood protection, irrigation, power development, sewerage, water supply, reports, estimates and appraisals. Business will be continued under the firm name of Hiram Phillips Engineering Co., Fullerton Building, St. Louis, Missouri, and in Paragould, Arkansas.



RUSSELL 1 3 TO 3 4 YARD DRAG LINE BUCKET.



RUSSELL DRAG LINE MOUNTED ON TRUCK.

RUSSELL DRAG LINE IN SERVICE.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 May 20, 1922 No. 20

SPRINGFIELD-WEST SPRINGFIELD BRIDGE WITH 110 TO 176-FOOT SPANS

Springfield-West Springfield Bridge

54,000 cubic yards of concrete, 3,560 tons of steel and nearly 11,000 foundation piles required for bridge.
General plan and principal details of 1,494 foot structure 80 feet wide and 56 feet high across the Connecticut River. Seven 5-rib reinforced concrete two-hinge river arches of 110 to 176 feet spans. Slab viaduct approach spans with concrete columns and steel columns enclosed in concrete. Concrete river piers on wood, shore piers on concrete pile foundations.

The new highway bridge across the Connecticut river at Springfield is a monumental $4,000,000 structure with graded approaches, 314 feet of viaduct and a seven-span river section 1,180 feet long, 80 feet wide and with roadway 56 feet in extreme height above low water. It will carry two 10-foot sidewalks and a 60-foot roadway with two electric car tracks, thus providing for one line of street cars and two lines of traffic moving in each direction simultaneously, and having a much greater capacity than the combined capacity of the two previously existing bridges that cross the river at Springfield.

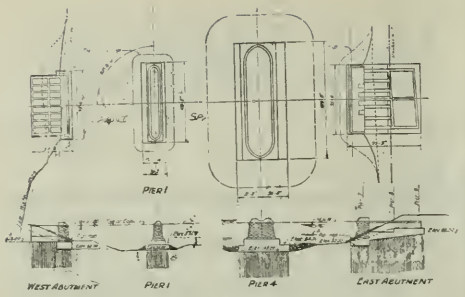
The clearance above low water is more than 40 feet for a length of 60 feet in the channel span, an amount which is greater than that of the existing bridges at Springfield and is approximately the same as the highest span at Hartford. The clear span and height above the water were fixed in accordance with the requirements of the War Department and will probably suffice for all navigation necessities, although it is so designed that the channel span can be replaced by a draw span if such action is necessitated by future demands.

The bridge is being constructed under an act of the Massachusetts State Legislature of 1915 by the Hampden County Commissioners. A contract covering the greater part of the work was awarded April 3, 1920, for $3,254,883, the highest bid received being $4,167,000. The bridge and the greater part of the approaches is expected to be completed July 31, 1922 at an estimated cost, exclusive of land takings and damages, of approximately $4,000,000.

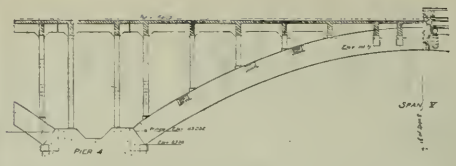
GENERAL FEATURES.

Exploration borings in the river bed, subsequently confirmed by dredging and pile driving operations, indicated sand or gravel to a depth of 15 to 25 feet, then clay to a depth of 100 feet or more, with a hard stratum 50 feet below low water level. The substructure of the river bridge was therefore designed with concrete footings on wooden pile foundations so proportional and arranged that after completion of the bridge the waterway will be approximately the same as before operations were commenced, and as large as that at any of the other existing Springfield bridges.

In the architectural treatment an attempt has been made to obtain a pleasing outline with little ornamentation. The channel span is flanked by four towers rising to a height of 84 feet above the sidewalk and having lanterns at the top. The two



PART PLAN DIAGRAMS OF SUBSTRUCTURE



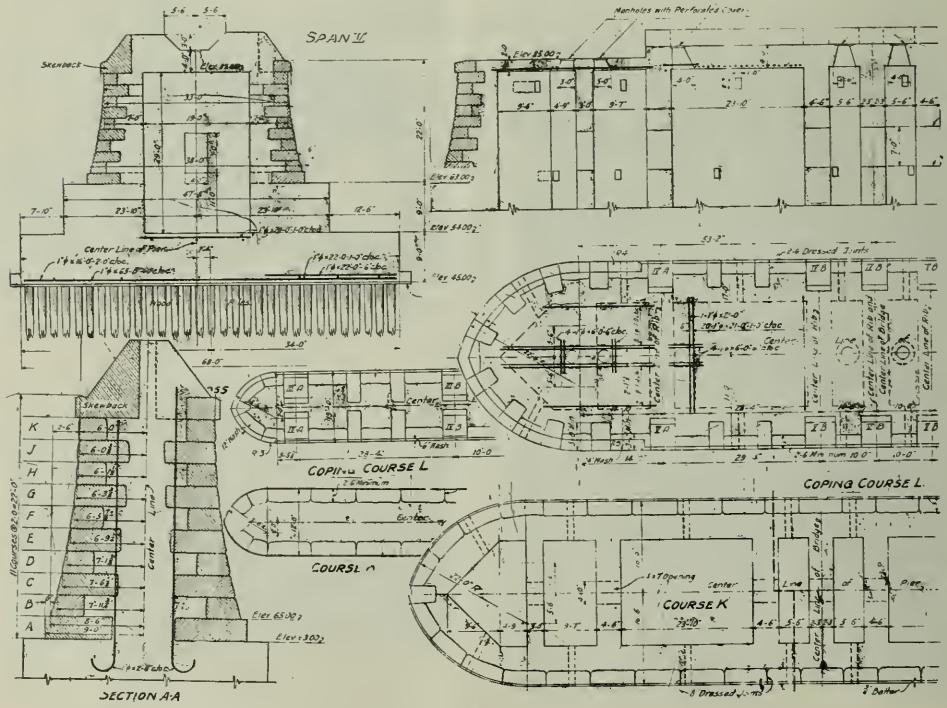
HALF ELEVATION OF CHANNEL SPAN AND PIER

spans on either side of the channel span are symmetrical about the channel span, and their shore ends are emphasized by towers 26 feet high above the top of the railing. The west end of the bridge is balanced by the concrete viaduct at the east end of the bridge.

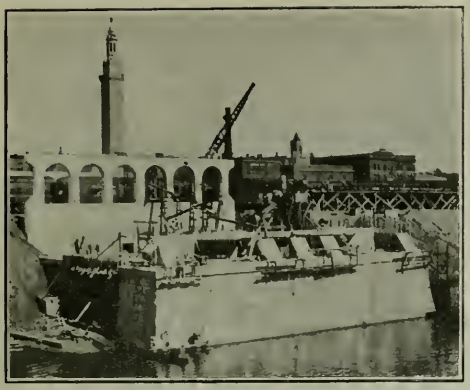
The piers and the abutments are faced down to a point below water level with granite about three feet thick. Artificial stone ornamentation is provided at the ends of all piers and at the center of the channel span. The railing on the river spans is of open balustrade type and that on the approach viaduct is solid. The entire cost of the ornamental features, including the eight large and small towers, the cartouches on the channel span and the pier ends, is less than two per cent. of the total cost of the structure.

Sixty lines of ducts with manholes about 300 feet apart are built under the sidewalks and provisions have been made for gas and water mains under the deck slabs. The roadway will be paved with granite blocks with bituminous filler and the sidewalks will have a granolithic finish.

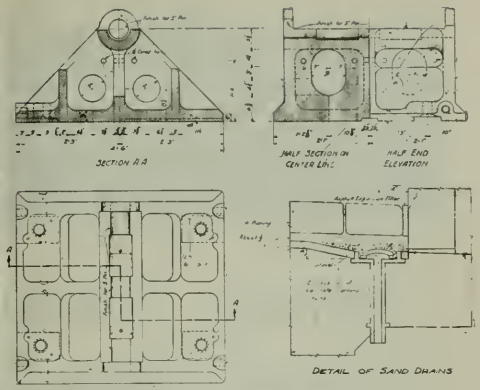
Extensive improvements are involved at both ends of the bridge on account of the elevation of grade, which on the Springfield side is about 15 feet maximum, involving a slope of about 3½ per cent. in all directions, of the street surfaces from the end of the bridge. In West Springfield the considerable amounts of land and grading necessary for the approaches have been donated to the county, and the roadway in the improved territory will first be



TYPICAL DESIGNS FOR MAIN AND INTERMEDIATE RIVER PIERS FOR ARCH SPANS



PIERS FOR APPROACH VIADUCT AND ABUTMENT



CAST STEEL PEDESTAL AND FLOOR DRAINS

constructed with a width of 60 feet, which may be eventually increased.

Except for a short grade of little less than four per cent., the maximum grade is 3½ per cent., which obtains over only a comparatively small part of the structure, the profile being a flat curve and level over the channel span.

RIVER PIERS AND ABUTMENTS.

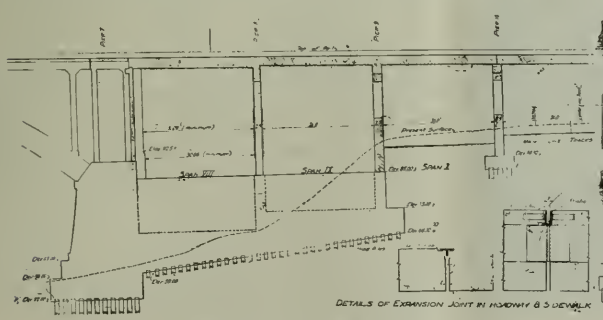
The seven arch spans are supported on two abutments and six intermediate piers, all having wood foundation piles with their tops embedded in concrete footings carried down to different levels from elevation 42 for pier 6 to 50 for pier 1, and to elevation 52 for both abutments.

The 10,500 pine foundation piles are from 20 to 40 feet in length, are spaced about two feet apart on centers and carry maximum construction loads of nearly 16 tons. The bottom of the concrete in the piers was required to be at least 18 inches below to tops of the piles.

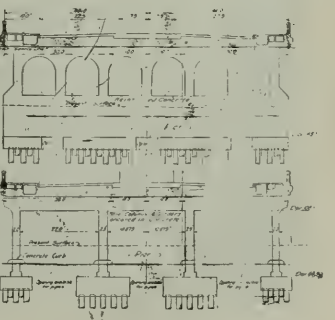
Piers 4 and 5 under the channel span are of special construction with a greater width than the other piers so as to provide independent stability and resist the unbalanced horizontal thrust of the adjacent arches in case it should become necessary to remove the channel arch span and replace it by a draw span at some future date. These piers are duplicates, with a 68x159-foot concrete footing, 9 feet in depth, supported on 2,263 piles and protected by rip-rap. The second course of the footing is narrower than the lower course, having a width of 47 feet 8 inches while the length remains the same, 68 feet. The upper surface of this course is nearly 2 feet below extreme low water and supports the main shaft of the pier 22 feet high, which is pointed at both ends and batters slightly to a width of 34 feet and a length of 155 feet at the coping. It is faced with eleven 2-foot courses of granite, headers and stretchers, all cut to plan. Above the coping there are granite skew-backs 5 feet 3 inches high, to receive the ends of the arch ribs.

To reduce the volume of concrete and diminish the foundation load, the pier is made hollow with eight chambers 19 feet long parallel to the bridge axis and 29 feet high, the widths varying from 5 feet 6 inches to 23 feet 10 inches. The chambers are separated by concrete walls 4½ feet thick, covered by reinforced concrete deck slabs 2 feet thick, and accessible through covered manholes in the deck. The outer walls of the chambers or the sides of the piers are at least 7 feet thick.

Intermediate pier 6, adjacent to the east abutment, has a 42x109-foot footing supported on 950 foundation piles, and the lower base is reinforced by 1-inch steel bars 5½ inches apart on centers in a horizontal



SECTIONAL ELEVATION OF ABUTMENT AND ADJACENT APPROACH VIADUCT



VIADUCT PIER AND CROSS SECTION

plane just above the tops of the foundation piles. The lower course of the footing is 11 feet deep and the second course is 10 feet deep. The pier shaft above is faced with granite and is reinforced with vertical rods to resist possible bending stresses during construction. The other intermediate piers are similar to pier 6, but have varying widths and numbers of piles in their foundations.

The abutments are very large, rectangular, cellular structures with massive continuous footing slabs, that for the east abutment being 95 feet 9 inches x 99 feet 3 inches in plan with a minimum thickness of 6 feet and supported on 1,806 piles. This abutment is 38 feet high to the top of the skewbacks and the exterior walls are faced with granite on parts of three sides down to elevation 63. The 54-foot 6-inch by 93-foot 6-inch footing for the west abutment is supported on 725 piles.

The substructure of the entire bridge contains about 34,000 yards of concrete and 4,700 yards of granite quarried at Cape Ann, near Gloucester, the granite being cut to dimensions and numbered before shipment.

(To be continued)

Garbage Collection in Goldsboro

Methods and Cost of Municipal Collection in a City of Twelve Thousand Population. New System of Accounting Gives Classified Costs by Months

Goldsboro, N. C., has a population of about 12,000. The city limits are irregular in shape and the city has maximum dimensions of about 2½ miles north and south and 1¾ miles east and west. It is fairly level. The Atlantic Coast Line Railroad passes north and south a little to the west of the center, while the Norfolk Southern Railroad crosses it from west to east. More than half the street mileage of the city is paved with asphalt, bitulithic and brick.

The city is governed by a mayor and board of aldermen, while a city manager, W. M. Rich, is employed by the board. The following facts with reference to the collection and disposal of garbage in the city have been furnished to us through the kindness of Mr. Rich.

Garbage, ashes and rubbish are collected by municipal forces, the cost being taken care of by direct taxation. The equipment for collecting garbage and rubbish consisted of five one-horse carts and a Ford truck until December 1, 1921, on which date the use of the truck was discontinued and an additional one-horse cart was substituted for it, it being considered that the truck was less efficient because of the continual stopping and starting. The city owns the horses used in collecting and pays the drivers $2.50 per day of ten hours.

Garbage and rubbish are disposed of at the city dump, which is on low land near the southern boundary of the town and alongside the railroad right of way. One of the main streets of the town leads past the grounds and is paved with asphalt to within about a half mile of the grounds. At this point the garbage and rubbish is dumped, the dumping and handling at this point being carried on systematically by a man who looks after both the dump and an incinerator that is located there, with occasional assistance of an extra man, although the cost of the extra man last year was kept down to $12 for the year. The refuse is dumped on the low land at the disposal grounds in layers about five feet deep, and a fire is kept continuously burning which disposes of practically all the combustible matter. The incinerator referred to is used only for disposing of dead animals.

Last year the city adopted a health and sanitation ordinance, one of the requirements of which is that "all business houses and private residences within the city are required to obtain a standard metal garbage can supplied with a cover which shall be placed at such location and at such times as shall be provided for by regulations which the city shall provide from time to time. Such regulations shall be published in a local newspaper and the public thoroughly acquainted therewith."

Garbage is collected twice a week, that on the north and south streets being collected on Tuesdays and Fridays and that on the east and west streets on Mondays and Thursdays. Wednesdays and Saturdays are used for the collection of ashes and rubbish, although some garbage also is collected on these days in case the housewife has forgotten to put it out on the regular days of garbage collection. Garbage and rubbish receptacles must be placed at the curb for collection, except in the case of hotels and restaurants in the downtown district.

During the past two or three months an effort has been made to determine as accurately as possible the amount of material which is being collected. Unfortunately there is no equipment at the dump for weighing each cartload. In order to estimate the amount of collection, the sanitary officer weighed on scales the collections made on days which were selected by him as average days. From this weighing and estimating it was concluded that, with an average collection of five loads per cart per day, the average weight was 1,000 pounds per cart. As there are six carts collecting, this gives a total of 15 tons per day. The garbage being collected four days a week would give 60 tons a week.

This amounts to approximately 520 pounds per capita yearly. This is two or three times greater than the average of the quantities usually reported by cities, and would apparently indicate that the people of Goldsboro are wasteful, or possibly that they place in the garbage pails considerable material not classified as garbage in other cities.

In checking up the collection of ashes and rubbish, it was found that the weight of this material averages per day of collection the same as garbage, or half as much for the year.

All of this work, together with the street cleaning, is supervised by an official called the sanitary officer who receives a salary of $1,680 a year. This salary is charged as follows: to street cleaning, $405; removing garbage, $810; removing rubbish and trash, $405; removing dead animals, $60. The man who looks after the incinerator dump is paid $75 a month and, as stated before, is aided occasionally by an extra man, which aid totaled only $12 last year.

During the latter part of the last fiscal year, which ended June 1, 1921, the officials devoted a large part of their energies to trying to perfect the organization in order to reduce complaints, which were very prevalent about a year and a half ago. This has been so successful that at present not more than six complaints a month are received. As soon as a complaint is received it is investigated in person by the sanitary officer, which investigation usually shows that the person making the complaint has told an untruth.

On June 1, 1921, a new budget system was adopted which provides a means of keeping very closely in touch with the cost of administration of the various city functions. Prior to this it was impossible to determine the cost of the various operations, but these can now be determined quite closely. The accompanying tables give the cost for the first eight months of the present fiscal year, No. 1 showing the costs of the department by months, and No. 2 the classified costs of the different departments for the eight months' period.

Schedule No. 1—Costs of Services, by Months

1921	Incinerator and garbage grounds	Removing garbage	Removing rubbish and trash	Removing dead animals	Totals
June	82.75	502.12	292.72	5.00	882.59
July	123.25	483.69	211.30	5.00	823.24
August	85.55	459.63	241.05	5.00	791.23
September	75.00	450.57	267.11	5.00	797.68
October	161.62	639.90	242.83	5.00	1049.35
November	85.35	501.51	224.85	5.00	816.71
December	79.00	496.64	197.71	5.00	778.35
1922.					
January	90.50	456.10	186.88	5.00	738.48
Totals	783.02	3990.16	1864.45	40.00	6677.63

Schedule No. 2—Clasisfied Costs for the Eight-Month Period

Items	Incinerator and garbage grounds	Removing garbage	Removing rubbish and trash	Removing dead animals	Totals
Salaries expense		540.00	270.00	40.00	850.00
Wages expense	612.00	2184.17	1119.74		3915.91
Fuel	64.75	116.51	31.14		212.40
Supplies for operating equipment	3.15	25.55	3.61		32.31
Supplies for subsistence of teams		796.72	291.26		1087.98
Tools and equipment replacements	2.10	22.25			
Material for building repairs	1.55	0.75			2.30
Material for equipment repairs	10.50	102.57			113.07
Contracted repairs	88.97	201.64	148.70		439.31
Totals	783.02	3990.16	1864.45	40.00	6677.63

RUBBISH CART USED IN GOLDSBORO

The cost of collecting the garbage during the eight months is shown to have been $3,990, giving a unit cost of $1.90 a ton. This cost per ton for collecting is below the average cost of a number of cities, which would indicate that the work is being done quite efficiently. The cost of collecting the rubbish was $1,864 which, using the estimated total amount above given would make the unit cost $1.78 per ton. A regular charge of $5 per month is made to cover the removal of dead animals. Horses, mules, etc., that are brought to the incinerator are disposed of there, but the city does not itself remove the larger animals and the charge made against the sanitary officer's salary in this connection is for that portion of his time which is used in investigation reports of dead animals.

Buffalo Filtration Plant

The Bureau of Water, of Buffalo, N. Y., is engaged in preparing plans for a filtration plant which will comprise forty filters, each with a normal capacity of 4,000,000 gallons per day. The construction will involve about 400,000 cubic yards of earth excavation, 5,000 cubic yards of rock excavation, and 50,000 cubic yards of reinforced concrete masonry in the sub-structures. These will consist of a low-lift pumping station, approximately 60 feet by 200 feet in area; a headhouse or coagulant building approximately 60 feet by 115 feet, and a filter building approximately 250 feet by 330 feet. It is expected that plans for these structures will be ready

PUBLIC DUMP AT GOLDSBORO

for receiving bids within the next month. The pumping plant and other mechanical features will presumably not be ready for bids until some time later.

The Use of Local Mineral Aggregate in Bituminous Macadam Roads*

The proper use of local mineral aggregate in bituminous road construction means great economy in these days of high transportation and labor costs.

It is possible to build good bituminous macadam road surfaces with practically any stone or coarse gravel found in the United States, provided this aggregate is free from loan, dust and silt when used.

The bituminous mixture is at best a wearing surface like the rails of a railroad and it must be thoroughly and properly supported by the subgrade or it will fail. The subgrade is the real road—it must be properly placed, thoroughly drained, well settled and compacted, and, on such a subgrade, a bituminous surface can be laid successfully with a mineral aggregate of comparatively low crushing strength, except on main trunk lines. It is, of course, very necessary to thoroughly bond this aggregate and keep it free from moisture, dirt and dust, for these are, in my opinion, the greatest enemies of proper bonding. * * *

Main trunk lines should have wearing surfaces which will carry any traffic and any speed, without failure, in spite of minor defects in the subgrade, but such surfaces are not necessary on minor roads and it is not economy to build them.

The safe crushing strength of trap rock or basalt averages approximately 350 tons per square foot; of the granites, 350 tons per square foot; of the limestones and marbles, 300 tons per square foot; of good air-cooled slag, 300 tons per square foot; of the sandstones, 215 tons per square foot; and ordinary chalk, 15 tons to the square foot.

Practically all the stone in this country comes within these limits and all of it save the chalk and very soft sandstones will make good bituminous macadam road surfaces. Specifications must vary with the types. The softer aggregates must be used in larger sizes, greater care exercised with them to keep out the dust and the rolling must be governed by the type of aggregate. The harder stone can be thoroughly compacted by heavy rollers and still penetrated and thoroughly bonded by the asphalt or tar, but the softer stones, when used in penetration work, must not be rolled as hard or they will not allow the binder to properly fill the voids, and care must be taken to keep the aggregate even, as many quarries have seams or stratums of soft shaley stone, which, if put in with the better material, will cause trouble.

More care must be taken with the top course or seal coat, when the softer aggregates are used, to insure a thorough coating on the actual wearing surface. * * * Of all the failures of bituminous macadam surfaces which have come to my notice, none have been due in any way to the character of the mineral aggregate.

I know of one piece of penetration surface in which three experimental sections were laid, each of about 500 feet. In these sections were used trap rock or very hard basalt, limestone (just an average grade) and sandstone of good character, while on all the rest of the road granite of good grade was used. This surface was laid in three layers of 2 inches, 2 inches and 1 inch. Two years after opening, a seal coat was put on and nothing has been done with it in the past six years. The same materials were used on the seal coat and I can distinguish no difference at all in these four sections of pavement. This road has carried up to 400,000 cars and trucks per season of eight months and the pavement is in perfect condition; but, it is laid on a perfect subgrade and 18 inches of telford.

Between the entrance of a ferry slip and the foot of a mile-and-a-half long hill, brick paved, on concrete base, with grades from 5 per cent. to 8 per cent., there is a rock fill 300 feet long. As this fill was expected to settle, it was decided to lay a temporary cinder surface on it. Three inches of clean steam cinders were spread and rolled with a 10,000-pound roller and one gallon per yard of bituminous binder was applied and lightly covered with more cinders. Two years later, another application of ½ gallon per yard of binder was made and lightly covered with cinders; at the end of another two years, this 300 feet of temporary surface is in perfect condition and more than 330,000 cars and trucks used it during the last eight months, and yet the crushing strength of cinders is not great.

In Eastern Ohio and Western Pennsylvania, much slag has been used and when treated about like limestone has made good surfaces. Many surfaces have been laid with crushed gravel, which is, of course, just like good crushed stone, if properly screened and washed before crushing. The usual specifications for this aggregate is 60 per cent. or more of material to have angular fragments.

But some surfaces have been laid with gravel without crushing and when this aggregate was clean, properly sized and bonded, these surfaces have been good. In Massachusetts and other New England States, this uncrushed gravel aggregate has been extensively used in the so-called "Tar Concrete Pavements" with success when the workmanship was good, and many old gravel roads have been successfully surfaced with only gravel aggregate.

Good workmanship means more in bituminous macadam surfaces than mineral aggregate does. It would seem much wiser for the engineer to carefully study all available local mineral aggregate and prepare his specifications to permit the greatest possible use of it in his surfaces, than to fall into the easier method of copying standard specifications and so compelling contractors to import these aggregates and so greatly increase costs.

Better put this extra money in your subgrade work, for that is really your road.

*Excerpts from paper by W. A. Welch, general manager and chief engineer, Palisades Interstate Park Commission, read before the Good Roads Congress, January 17.

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Well Co-ordinated Bridge Design

It is not necessarily or even probably the most valuable achievement or highest engineering to build a structure that is only the greatest, strongest, cheapest, or even the most beautiful or useful that can be made. The coordination of all these functions giving full and properly proportioned recognition to each with due consideration of surroundings, requirements, and harmonious whole; with provision for future development, maximum safety and the highest ratio of efficiency and durability to total cost, is the truest success.

Engineering development and improved standards are eliminating raw construction that in former years has been due to lack of development, facilities, funds and appreciation; omissions that have been especially apparent in great bridges where the precise computation of theoretically accurate strain sheets (based on assumed data), has been a temptation to build flimsy or offensive structures with little regard for beauty and durability. Structural steel is indispensible but its highest value and efficiency are secured when it is properly used, often supplementary to other materials, and the present tendency is to combine it with concrete for bridge superstructures except for the longest spans.

A case in point is the new Connecticut river bridge described on page 365, where a large sum has been wisely expended to provide a beautiful permanent structure of high economic value. The attention given to numerous considerations indirectly affecting its service and its relation to public requirements may almost be said to have produced a judiciously weighted design. It embraces well-developed improvements in advanced practice rather than radical or experimental features, thus insuring construction of a monumental character with full recognition of practical, financial, and artistic requirements.

Important features of its design are the balanced symmetry of outline relieved by graceful towers and the handsome cartouches on the main span that cost less than two per cent. of the total; the ashlar faced substructure; the proportioning of the river spans with graceful outlines and moderate dimensions providing for waterway and navigation at moderate cost; and ample approaches so satisfactory that they were largely donated by local interests.

Notable details of the design include self-supporting arch rib reinforcement eliminating falsework; graded rib concrete; rational type foundations; economic hollow piers; accurate and permanent arch adjustment; high class paving and roadway drainage; design facilitating erection; and independent arch stability for future radical reconstruction. Most of these features were particularized in the specifications and drawings and all of them, and more, are worthy of consideration for adoption or modification in many municipal bridge schemes.

New York Transit Construction

If the plans announced May 11 by the New York Transit Commission are carried out substantial relief will be afforded within five years to all of the passenger traffic of the city which has long been subject to constantly increasing inadequacy of facilities that are already disgraceful and intolerable.

Recent official investigations have shown that nearly all lines are seriously overcrowded and some of them, at the peak, are more than 100 per cent overloaded, causing great delay and dangerous conditions that seriously menace the health and comfort of millions of passengers and restrict the development and progress of the city.

Physical, financial and geographical conditions limit transit construction so much that it is doubtful if it will ever be settled in a completely satisfactory manner or entirely catch up with the demands that have hitherto increased faster than the facilities. For several years there has been an almost total cessation of improvements in traffic conditions, but vigorous action of the Rapid Transit Commission now promises prompt relief, which is badly needed.

The completion of detail designs should be hastened to the utmost and contracts awarded as rapidly as possible, giving the work under fair conditions to experienced and reputable contractors many of whom have successfully executed similar work and

are available to commence construction as soon as permitted and assured of fair and honest treatment.

The contracts should recognize the rights of the contractor and allow him fair profits and necessary freedom of action, and special care should be taken to provide against delay in furnishing him with necessary information, authorization and prompt payment for work satisfactorily executed. Reform is urgently needed for some clauses of former contracts whereby contractors were specifically held responsible for matters in which they were not free to exercise their best judgment, or conditions not under their control, and for the engineers' orders.

Some of the proposed work involves great engineering difficulties and will necessarily be costly. Probably there is nowhere else in the world that men and equipment so well qualified to execute the work successfully are available. They should be well compensated for its successful execution, which will not only vastly improve transit conditions but which will greatly stimulate construction work and general prosperity.

$318,000,000 Transit Contracts for New York

The New York Rapid Transit Commission announces plans for the extension of the present New York system by seven new lines which it is estimated can be put in service in five years.

These lines, in order of proposed construction are: Corona $2,800,000 extension; 42nd Street $6,000,000 crosstown; Staten Island $20,000,000 ferry and passenger tunnel; Broadway-7th Avenue $26,500,000 extension; Brooklyn $24,000,000 crosstown subway; Manhattan-Brooklyn $25,000,000 or $28,000,000 subway and tunnel; and the Manhattan-Washington Heights $69,500,000 subway.

The Flushing line will be a 3-track elevated structure from Corona to Flushing Circle drawbridge, thence a subway to Main Street and can be built in 3½ years.

The 42nd Street moving platform under the sidewalks would eliminate the present long walk and two waits and extended from river to river, will ultimately provide transfers for 27 up and downtown tracks. It can be built in 3 years.

The Staten Island connection may be a continuation of the 4th Avenue Brooklyn subway to Fort Hamilton, tunnel to Vermont Avenue, Staten Island, which can be built in 5½ years and supplemented by a ferry connecting Staten Island with the subway system in only 2½ years. Alternative to this plan is a tunnel from 67th Street, Brooklyn, to Arietta Street, Staten Island, also in 2½ years.

The extension of the Broadway-7th Avenue subway from 59th Street, Manhattan, to 155th Street and 8th Avenue, will afford the quickest possible relief by the completion in 3½ years of another full-length north and south line.

The Brooklyn crosstown line will follow Jackson Avenue, Long Island City, Manhattan Avenue, Greenpoint and Roebling Street to Bedford Avenue, Brooklyn, and with the Brighton Beach line at Fulton Street and Franklin Avenue and can be completed in 3½ years.

The Manhattan-Brooklyn line contemplates the removal of the elevated railroad in Fulton Street, Brooklyn, and construction of subway from Fulton and Clermont Streets to Sidney Place. From Sidney Place, two tunnel routes are available to the City Hall, New York. One runs from Grace Court, under East River to Nassau Street; the other from Livingston to Clinton Street, Liberty Street and Fulton Street, Brooklyn, under East River to Ann Street, Manhattan.

The Manhattan-Washington Heights line connects with the Queensborough subway at 41st Street, runs south 4-track through 8th Avenue to 14th Street and 2-track to Hudson and Chambers Streets. North, it is 4-track through 8th Avenue to 57th Street and Amsterdam Avenue to 155th Street, thence 3-track to 181st Street. It will be constructed in four sections, the first from 41st to 14th Streets, with 4 tracks with provision for 8 tracks, will cost $19,000,000; the second from 14th Street to a Chambers Street terminal, $7,500,000; the third, a double-deck, 4-track subway from 41st Street to 103rd Street, $24,000,000 and the fourth from 103rd Street to 181st Street, $26,000,000. All sections can be completed in 4 years.

The total construction cost is estimated about $174,000,000; administration, interest and engineering, $44,000,000, and equipment, $100,000,000.

Passaic Valley Sewer Tunnel

Work is about to be resumed on the outlet tunnel of the Passaic Valley sewerage system which has been under construction for several years.

The present contract, which was awarded to Holbrook, Cavot & Rollins for about $2,000,000, involves the construction of an outlet shaft and chamber house at Robbins Reef off the Staten Island shore, and a concrete lined tunnel 12 feet in inside diameter and about 15,000 feet long connecting the foot of this shaft with the abandoned tunnel started some years ago from the Jersey shore.

Part of the old tunnel invert has been concreted and this will have to be cleaned, re-excavated and the remainder of the lining completed and the new tunnel will be driven from two shafts.

The tunnel is partly in rock and partly in earth, but will probably all be driven under air pressure. The old plant is being repaired and supplemented and the work should be completed in 1924.

Water Consumption in Springfield

The daily average consumption of water in Springfield, Mass., in 1921, was 12,870,000 gallons, equivalent to 90 gallons per capita. About 900,000 gallons were used for municipal purposes, about 60 per cent of which was metered, this including most of the schools and other public buildings and the parks.

The highest rate of use of water for any hour during the year was occasioned by the use of city water for flushing snow through the sewers on February 23rd, when a rate for a short time of 27,500,000 gallons per day was recorded. Nearly 12,500,000 gallons were used for this purpose in four days during February, and destroyed all fire protection in many districts, and many of the suburban users complained that they were entirely without service. The largest used for fire fighting was 1,388,000 gallons on January 18th.

The largest amount of consumption in any one day was 16,340,000 gallons on June 22nd, and the smallest was 9,790,000 gallons on April 17th. As nearly as could be determined, regular sewer flushing took a little over 27,000,000 gallons of water during the year.

Columbus Filtration Items

Repairs Made in Solution and Dissolving Tanks, Stirring Machinery and Filters

The water softening and purification works of Columbus, O., last year treated 7,936 million gallons, about nine per cent less than in 1920. The bacteria were reduced from an average of 2,450 per c.c. in the raw river water to 24 in the filtered water: and the hardness from 269 p.p.m. to 100 p.p.m.—the lowest for six years past.

Considerable repair work has been required about the plant. Some of the more important items were as follows:

Repairing of Alum Solution Tanks and Alum and Soda Ash Dissolving Tanks—The alum solution tanks and the alum and soda ash dissolving tanks were beginning to disintegrate on the inside. These tanks (seven in all) were bush hammered and resurfaced with a rich mixture of cement and high silica sand.

Lead-lining Soda Ash Solution Tanks—The soda ash solution tanks have leaked more or less ever since the plant was put into operation thirteen years ago. A great deal of time and money has been spent in trying to stop this leakage, but without success. Shortly after these tanks were put into service an attempt was made to make them watertight by resurfacing the inside with a rich mixture of cement and high silica sand. This didn't do much good, so the tanks were resurfaced on the inside with a black asphaltic compound called "Bitumenastic." The soda ash was sometimes run into the tanks too hot and melted the Bitumenastic, so that the treatment was not successful. Later several attempts were made to stop the leaking by resurfacing the inside of the tanks with California Asphalt, but this treatment afforded only temporary relief.

These tanks are located on the third floor of the headhouse, and the soda ash was commencing to disintegrate the floor of the headhouse, thus endangering the whole structure, and it became absolutely necessary that these tanks be made tight. This summer they were lined with sheet lead, weighing eight pounds to the square foot, and are now holding satisfactorily.

Repairing stirring machinery in the Lime Saturators—The saturators have been given a complete overhauling during the past year. All bent paddles have been taken off and straightened, all broken shafts have been replaced, and on some of the saturators new belts have been provided, so that this part of the plant is in perfect condition.

Repairing the Stirring Machinery in the Lime Solution Tanks—The stirring machinery in the lime solution tanks has been a cource of petty annoyance for years because the paddles were too light. The accumulation of sludge to any depth at all would bend and twist the paddles and break the shaft gears. All of these paddles have been taken out during the past year and replaced with heavier ones.

Repair Work and Improvements Made to Filters and Filter Gallery—As the softened water passes through the filters, normal carbonates are deposited on the surface of the sand and also around the sand grains, causing them to grow in size. If this is allowed to go on indefinitely a mat forms on the surface of the sand and this mat in time becomes so heavy that the filters will not wash well, so that it is necessary to scrape this material off the filters occasionally, and also to throw out some of the sand. It is necessary to throw out some of the sand occasionally because the grains grow so in size, due to incrustation, that the sand level reaches up to the bottom of the wash troughs. This scraping and removing of sand has been done twice to all of the filters during the past year.

Tank Treatment of Sewage

Separate Sludge Digestion Tanks in Baltimore. Suggestions for Imhoff Tanks. Imhoff Tank Difficulties Due Largely to Faulty Design and Operation

In connection with the discussions of the advantages and difficulties experienced with Imhoff tanks that have appeared in PUBLIC WORKS during the past two months, it may be of interest to publish part of a paper by George T. Hammond read last winter at a symposium on sewage disposal held by the American Society of Civil Engineers. The portions having special bearing upon this question are as follows:

There has been an evolution from the ancient and odorous cesspool to the sedimentation and separate sludge-digestion tanks of this day. Experience and experiments go far to prove that the latter afford the most satisfactory method of tank treatment, securing a very high removal of suspended solids and complete digestion of the sludge, without much danger of a nuisance. Much experience with the design and operation, as well as with overloading and abuse, of such tanks, was gathered during the recent war, and the interested student can inform himself of many data from several important papers since published, of which I will only mention that presented by Major L. S. Doten to this society, which will be found with interesting discussions in Volume 83, page 337, of the "Proceedings."

One of the latest extensive projects in sewage treatment is the proposed enlargement of the Baltimore plant, concerning which the following statement has recently been made: "Everything points to the adoption of sedimentation tanks in conjunction with sludge digestion tanks as the most logical

solution of the problem for Baltimore conditions. None of the many troubles that have to be confronted in the operation of Imhoff tanks are found in treating sewage with sedimentation and sludge digestion tanks. No foaming is met with; no time is spent squeegeeing; no scum has to be removed; no skimming of tanks is required; and no uncertainties of operation have to be considered."

Our experimental work in Brooklyn on sewage treatment, extending over more than five years, appears to justify the conclusion reached in Baltimore as to the success of sedimentation and separate digestion, but we did not find much difficulty with the Imhoff tank. Our Imhoff tanks were possibly on a better line of behavior than those in Baltimore.

The Imhoff tank affords a method of obtaining separate sludge digestion in a chamber placed under the sedimentation chamber. It eliminates the necessity of actually transferring the settled matter from one tank to another, and thus has an advantage over the separate tank system. But that it has some unpleasant tendencies must be admitted.

Among the points of interest observed during our experiments, I have only the available time to mention the following:

1. For Imhoff tanks the sludge digestion capacity should be sufficient to carry the sludge without discharging for 8 months, and the capacity below the slots should be at least about 2 cu. ft. per capita for the population served. This large storage capacity is not only necessary for storage during non-drying periods but also it appears to have some important relation to the digestive process, and helps to prevent foaming.

2. Double slots—i. e., one slot at the bottom of each inclined plane of the sedimentation chamber, with a triangular baffle beneath, instead of one plane passing under the other, appears to give the best result in these tanks and largely eliminates the need of squeegeeing the slopes.

3. The slopes should be at least 1¼ vertical to 1 horizontal, and the flow should be parallel with the slopes and slots. A rate of flow equal to 1 ft. per minute is excellent.

4. Scumboards and baffles add to tank efficiency.

5. From observation I have reached the conclusion that two sludge digestion pockets under the sedimentation chambers are better than three, and that the best length for the sedimentation chamber would afford 60 ft. net, for the flow between scumboards at inlet and outlet. Provision should be made to reverse the flow.

During the war, and while in the employ of the U. S. Government, among my various assignments, I was detailed to take care of the design of an Imhoff tank plant for Harriman Village and other industrial housing projects and the city of Bristol, Pa., jointly. W. H. Boardman of Philadelphia was retained by the city, and we collaborated on this work, which consisted of three Imhoff tank units, each of a capacity to care for 2½ mgd. of sewage flow at 1 hour retention, or 1¼ mgd. at 2 hours.

The principles above mentioned were carried out in the design. The plant has been in operation about three years and has given excellent service. I understand that there has been no trouble with this plant, no odors, and that squeegeeing of slopes is very seldom required.

Many engineers have come to the conclusion that the Imhoff tank is an element of risk in a treatment plant. After having visited most of the larger and many of the smaller installations of this tank in this country and abroad, my opinion is that its bad name is due to a considerable extent to faulty design, and still more to faulty operation.

A word about retention period in tanks: Experience and experimental work indicate that this period should be short, usually not over two hours, even as brief as one hour will give the best results in many cases. Sedimentation is very rapid during the first hour, septic action may intervene during the second hour, and it is always desirable to keep the liquid portion of the sewage as fresh as possible.

Experimental results as well as observation tend to show that a period of two hours, while not affording the high percentage of removal obtained by longer periods, gives all the preparation required for sprinkling filters, or for direct discharge into a water-way affording sufficient dilution.

Chippewa-Queenstown Power Canal

This canal, about 30 miles long, has just been completed by the Ontario Hyrdoelectric Power Commission at a total cost of more than three times the pre-war estimate for the ultimate development of 500,000 horse power, derived by bringing water from about 30 miles above the upper Niagara Falls rapids to a point just below the lower rapids and thus utilizing a working head of more than 300 feet.

The river intake consists of a concrete deflection wall and six large concrete pipes submerged 35 feet below water level and delivering into the canal, which consists of 3½ miles of the rectified channel of the Welland river and 9½ miles of a wide and deep canal excavated through earth and rock, the upper end of which for about one mile was excavated by a suction dredge to an average depth of 25 feet.

Part of the excavation was through earth and below it to a considerable depth in rock. At one point there was an earth excavation and a rock excavation 85 feet deep with a berm carrying construction tracks at the feet of the 1:1 earth slopes that were rip-rapped and finished with gunite.

Up to water level the channel has a lining concreted with the aid of a wooden traveler having vertical, longitudinal steel plate faces with screw adjustments that are set to form the inner face of a wall about 1 foot thick.

In one place where the canal is carried on an embankment the canal has a V-shaped cross section with rip rap slopes covered with concrete reinforced with steel wire netting. Concrete strips 2 feet wide were first laid from top to bottom of the slopes at 18-foot intervals and on them steel plates were set at the bottom of the slope, loaded down with sand bags and served as forms for concreting the intermediate panel. After the concrete had set the forms were pulled up the slope, the next horizontal strip concreted and so on to the top. Concrete was delivered in dump cars and spouted to position. The construction equipment included 50 locomotives, more than 400 cars and 30 miles of track.

Engineers' Plans for State Health Boards*

Regulations of the State Boards of Georgia, Illinois, Indiana, Iowa, and Kansas, with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits.

Georgia. The Board requires plans and specifications to be filed two weeks prior to the date upon which action is desired.

Water Supply. The plans are to include a map of the district showing the proposed system, detail drawings of any special structure, and general and detail plans for water purification works. There shall also be a comprehensive report by the engineer, who may submit a preliminary report for the Board's consideration.

The general plan shall be to a scale not greater than 100 nor less than 500 feet to one inch. If any dimension is more than two miles, the map may be in two or more sections bound together and a small index map supplied. The map shall show all streets, surface elevations at street intersections and elevations of water at intake, in reservoir, etc.; sizes of pipes; "location of intakes, valves, hydrants, reservoirs, pumps, standpipes and purification plant, and any special structures.

The dimensions suggested, except for the map, are the same as in Arkansas. In general, the last paragraph of the Arkansas synopsis (page 323, issue of May 6) apply to Georgia. In connection with the water shed, map required showing roads and buildings, and discussion of storage capacity, average depth and area of reservoir, liability of odors or tastes, removal of color, etc.

Sewerage. Required-map of district, profile of all sewers, details of appurtenances, plans of disposal works, and engineer's report.

Map—as for water supply, except no scale less than 300 feet to one inch, contour lines shall be shown at intervals of not more than 10 feet, all existing sewers, existing and proposed outlets and overflows. Street and sewer elevations as for Arkansas.

Profile and detail plan requirements as for Arkansas.

Minimum grades as for Arkansas. Capacity should be sufficient to carry, when flowing half full, twice the average flow of 25 years hence, plus ground water.

Dimensions of drawings, as for water works.

The report and specifications are to include items as for Arkansas, except the list of bench marks.

"Under ordinary circumstances the Board will approve such plans only when designed upon the separate plan, in which all rain water from roofs, streets, and other areas and all ground water, other than avoidable leakage, is to be excluded." (This should have been given for Arkansas also.)

*Continued from page 342.

Illinois. "No rules or suggestions relative to sizes, scales, etc., of maps and plans have been prepared."

Indiana. "The department is co-operative and wherever it is possible we ask that the Water and Sewerage Department of the State Board of Health be called in on plans merely to co-operate with the municipality to gain an efficient waterworks or sewage plant or sewers."

Iowa. Plans to be submitted at least two weeks before action is desired.

Water Works. General map of district and topographical map of catchment area and of reservoir site. Detail drawings of special structures. General and detail plans of purification works.

The instructions are closely similar to those for Arkansas, with the following exceptions: Specifications are requested typewritten on letter size paper. Plans for purification works shall show contours upon areas reserved for future extensions. Sizes of drawings, 24, 32, 40 or 48 inches long connections with pipes carrying less pure water must have valves that can be sealed by health board.

Sewerage System. A preliminary plan giving information sufficient for complete understanding of project must be submitted prior to submission of detailed plans.

The instructions are closely similar to those for Arkansas, with the following exceptions: Profiles, horizontal scale, 100 ft. to 1 in. Plans for a disinfecting plant are not part of the general requirements. Lengths of drawings as for water supply above. The last paragraph of the Georgia synopsis is used with the additional provision that "extensions to existing combined sewer systems may be approved"; but if combined sewage is treated, storm overflow must be controlled and reserve filters provided.

Kansas. Information required—general plans, detail plans, engineer's report and specifications.

Water Works. The map to show streets, street elevations, location of pipes, valves, etc., elevations of street intersections. If wells are used, location of houses, cesspools, swamps, sewers, etc., near enough to contaminate them. Scale from 100 to 300 ft. to 1 in.

Detail plans of purification plants to show arrangement, size and construction of sedimentation basins, mixing chambers and other features. Complete plans of lay-out, showing all devices, and filter company's plans.

The engineer's report should discuss for surface supply, the nature and extent of water shed, especially its sanitary condition and method of regulating or preventing pollution, with small map showing buildings, roads on watershed or within five miles of intake; capacity and details of reservoir. For ground supply, give depth, size, construction, etc., of wells or galleries, probable capacities, ground strata, description of tests. Population to be served, quantity of water to be supplied, depth of pipe.

Specifications for the whole construction must be submitted and estimates of cost are desired but not required.

(To be continued)

NEWS OF THE SOCIETIES

CALENDAR

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE. Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary, Edgar E. Harlan, Des Moines, Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff, 60 State St., Boston, Mass.

June 6-8—CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Idaho.

June 12-15—CANADIAN GOOD ROADS ASSOCIATION. Ninth annual meeting. Empress Hotel, Victoria, B. C. (Change of date.)

June 13—ENGINEERING SOCIETY OF AKRON. Akron, Ohio.

June 16-17—ENGINEERING INSTITUTE OF CANADA. Provincial meeting. Vancouver Hotel, Vancouver, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 15-18—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

ROSTON SOCIETY OF CIVIL ENGINEERS

The Boston Society of Civil Engineers has elected the following officers: President, Dugald C. Jackson; vice-president, Charles M. Allen; secretary, John B. Babcock, 3d, and treasurer, Frank O. Whitney.

RICHMOND CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

This chapter elected the following officers: President, J. C. Carpenter; vice-president, E. T. D. Myers, Jr.; secretary, Albert C Dunn, and treasurer, E E. Davis.

BROOKLYN ENGINEERS' CLUB

On April 29 about sixty members of the club were the guests of the United Electric Light & Power Company, New York, and after being entertained at a luncheon, the party was taken by automobile to the new Hell Gate Station at 134th street and East River, where the engineers inspected the 150,000 K.W. installation having many novel and interesting features in power plant line. This station is one of the largest and most complete, just built, and is intended to have an ultimate capacity of 300,000 K.W. Its construction has involved many interesting features, some of which regarding the intake and discharge tunnel have been described in Public Works.

TRI-STATE WATER AND LIGHT ASSOCIATION

The twelfth annual convention of the Tri-State Water and Light Association, of the Carolinas and Georgia, was held at Spartanburg, S. C., April 18-20. At this meeting it was decided to enlarge the geographical field of the association to include Florida, Alabama and Tennessee.

The new president of the association is J. E. Gibson, superintendent and engineer of waterworks, Charleston, S. C.; and W. F. Stieglitz, Columbia, S. C., was re-elected secretary and treasurer.

Among those discussing the various topics presented were E. L. Filby, sanitary engineer, S. C., state board of health; H. F. Lee, manager, Carolina Power and Light, Goldsboro, N. C., and W. M. Rich, city manager of Goldsboro. Waterworks appliances were exhibited.

NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

At its regular monthly meeting of May 17th the New York section, A. S. C. E., discussed the need for regional planning for the New York District. The discussion was opened by Charles D. Norton, first chairman of Chicago plan.

ROCHESTER ENGINEERING SOCIETY

At the meeting of May 5th the paper of the evening was on the history and manufacture of vitrified clay pipe by J. W. Lea. On May 12th the society was addressed by F. E. Colley, president of the Federated American Engineering Society.

On May 19th the society will be addressed by Dexter M. Kimball, president of the American Society of Mechanical Engineers and Dean of Sibley College, Cornell University.

AMERICAN ASSOCIATION OF ENGINEERS

The Rochester Chapter was addressed May 1st by John Dunbar, Superintendent of Parks, City of Rochester, on the work of the Park Commission.

PERSONALS

La Noue, W E., has resigned as city engineer of Victoria, Texas, and E. R. Thomas, of Port Arthur, has been appointed as his successor.

Lea, S. H., county engineer of Mineral County, W. Va., has resigned to accept an appointment as district engineer in charge of road construction for Cacapon district, Morgan County, W. Va.

Norckauer, W. H., has been appointed office engineer of the State Highway Commission, succeeding W. F. Cooper.

Davis, W. H., has been appointed maintenance engineer, West Virginia State Road Commission, with headquarters at Clarksburg.

Stoelting, R. E., formerly city planning engineer, Milwaukee, Wis., has been appointed commissioner of public works.

Graham, Alexander W., chief engineer of the Missouri State Highway Commission, has resigned, and his assistant, C. W. Brown, is acting chief until election.

Murray, C. W., for many years city engineer of Tampa, Fla., has been made director of public works and public welfare with an increase in salary. He will have charge of preparing plans for the city's $400,000 harbor development.

Leyden, Harry S., chief inspector of highway construction of Fresno County, Cal., has been appointed county superintendent of highway construction and maintenance, the appointment to be effective July 1st.

Hedrick, J. J., Jr., county engineer of Hillsborough County, Fla., has resigned, and Allan Pimm, his assistant, has been appointed county engineer.

Emerson, Fred, assistant city engineer of Lockport, N. Y., has been appointed city engineer of Batavia, N. Y.

Doan, L. A., until recently assistant engineer of bridge construction, Indiana State Highway Commission, has been appointed assistant district engineer in charge of bridges for the upper peninsula of Michigan.

Smith, E. S., of Youngstown, Ohio, has resigned as chief of the division of public works in the State Highway Department of Ohio on account of ill health.

Finck, George E., has been made highway engineer of Greensboro, N. C.

Wasser, Thomas J., state highway engineer of New Jersey, has been elected president of the newly created state board for licensing professional engineers and surveyors.

Reed, George A., Montpelier, Vt., formerly assistant state engineer of Vermont, has been appointed state engineer, succeeding D. O. Young, who resigned.

Torkelson, M. W., bridge engineer of the Wisconsin Highway Commission, has been appointed engineer secretary, and W. C. Buetow, assistant engineer, has become bridge engineer, succeeding Mr. Torkelson.

Whitfield, J. D., has been elected city manager of Terrell, Texas.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

GOOD ROADS MACHINERY COMPANY'S WINNER SPECIAL 2-WAY ROAD DRAG.

THE WINNER SPECIAL 2-WAY ROAD DRAG

The Winner Special 2-Way Road Drag, manufactured by the Good Roads Machinery Co., Inc., is simply two road drags, exactly alike in construction, joined together by a connecting link. It is designed and furnished to fill a very large demand for a drag of exceptionally large capacity to be used with traction power, and can be handled to advantage with six mules or with a 10-H. P. tractor.

The Winner Two-Blade Drag, with independently adjustable blades, suits average conditions of dragging. It is light in weight, but being built of steel, is exceptionally strong and durable.

The connection from one blade to the other is made adjustable so that the blades can be set at any angle desired independently of each other. By means of this special device the blades can be set for doing work that cannot be accomplished by the rigid blade types of road drags.

The operating lever is arranged with a long sweep in order to allow the blades to be set at sharp angles.

The link can be set at any point desired in the chain, thus regulating the angle of the drag when in operation.

The Winner Special 2-Way Road Drag in ordinary dragging work will cover about 15 feet of roadway. It is hardly necessary to say, therefore, that one of these drags will maintain a very large mileage of roads.

The drag complete weighs 635 pounds. It is equipped with four hooks at the rear, so that an extra drag, heavy chains or a leveling log or board can be attached for smoothing the roadway behind the drag.

This drag will appeal to users because of its ease of operation, durability and capacity for covering a large amount of roadway in a limited time.

Large numbers of these drags are being used with excellent results by the State Highway Department of North Carolina.

20-TON "B" ERIE STEAM SHOVEL

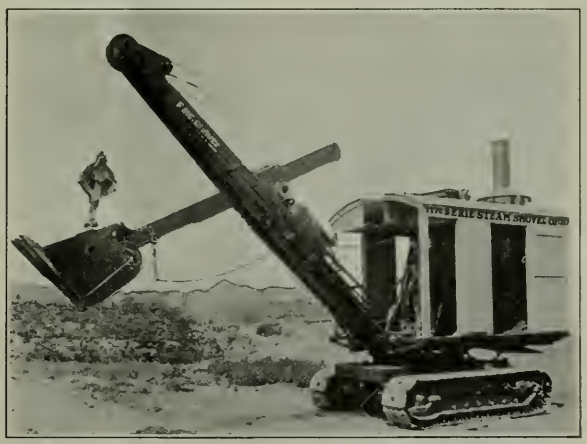
A re-design of the 1921 Erie Steam Shovel has been completed and shipments are now being made of the new machine, which retains all of the good features of the former one, of which more than 1,700 are now in service and have provided much important data for the determination of the correct sizes for shafts, bearings and other important parts of the improved model.

The new machine has more power than has been previously provided for steam shovels of the 20-ton class and is able to handle a full size ¾-yard dipper with a 21-foot boom and 18-foot 6-inch dipper handle. There are many improvements in the details of the trucks and turntable and the traction wheel mounting is interchangeable either with car wheels or with the lubricated caterpillar type introduced last season which has internal lubricating reservoirs.

There is an entirely new automatic tripping device that makes the operator's work much easier and lengthens the working season. The dipper has a double-hinged latch lever which cannot become bent and does not break wagon or car boxes. Many improvements have been made in the boom, the gears and the shipper-shaft besides a number at the power-producing end of the new machine, which has a larger boiler and a new auxiliary exhaust.

The new 1922-1923 Erie has a wider all-round usefulness than has previously been developed in one steam shovel and can be quickly converted to a locomotive crane to handle a clamshell bucket, orange-peel or dragline bucket; it is easily changed over to a steam hoe for trench excavation; or it can be readily equipped with trucks for railroad ditching. For regular steam shovel service it is suitable for road grading, cellar excavation, quarrying rock, excavating sand and gravel and other ordinary work. The steam hoe, traveling on solid ground in advance of trench excavation, prevents cave-ins and handles hard materials and large boulders with all the strength and power of a steam shovel.

The Erie Steam Shovel Company, by which the machine is manufactured, calls attention to the higher standard of workmanship and better materials in this machine than have been possible at any time before since 1916.



ERIE STEAM SHOVEL WITH INTERNAL LUBRICATED CATERPILLAR TRACTION AND AUTOMATIC BUCKET TRIPPING DEVCE.

A DOLLAR A DAY FOR FUEL

A few months ago the Bucyrus Co. announced the addition to its line of products of a gasoline shovel of a distinctly novel and very much improved type, the most revolutionizing feature of which was the ingenious method of operating the thrust without the use of an independent engine mounted on the boom whereby even more power is obtainable than with a steam shovel of the same size.

This company has now developed, after a long period of thorough experimentation, the use of a Diesel type engine for this shovel, the importance of which announcement lies principally in the greatly reduced fuel cost.

This shovel, known as the Bucyrus 30-B oil shovel, will use as fuel any cheap, low grade oil of high heat value which will flow freely.

This machine has been severely tested, both as a shovel and as a dragline, for several months, under strenuous winter conditions. With fuel oil at 6c per gallon it consumed 1¾ to 2¼ gallons of fuel oil per hour, or, roughly, between $1 and $1.25 per day of average operation.

The fuel cost of any shovel differs widely in different sections of the country. Conservatively stated, however, such a steam shovel will burn about 1½ tons of coal in 10 hours. With coal at $6 per ton delivered, this means a daily fuel cost of not less than $9. A saving of $8 per day on fuel alone is thus possible. To this figure may be added several other items thus eliminated, notably, the saving made possible in not having to pay the cost of a team to haul water and coal.

The engine is of the full Diesel type, not the semi-Diesel. It is a mechanical injection engine, developing 55-h. p. at the conservative speed of 360 R.P.M. Its cylinders are 8x10½ inches. It is a heavy duty, slow speed engine of particularly rugged and heavy construction.

This Diesel type engine differs from the gasoline engine principally in that it is a constant pressure engine, the fuel being burned directly in the cylinders without the aid of a carburetor, spark plug or outside heating appliances. In the gasoline engine the mixture is taken into the cylinders, compressed, and then ignited by some auxiliary mechanism. The pressure then rises in the nature of an explosion. In the Diesel type engine the fuel is injected into the cylinders at a constant pressure in an atomized state. It is fired by the heat developed by the compression of air in the cylinders on the previous stroke.

The 30-B oil machine, equipped with a Diesel engine, may be furnished either as a shovel, a dragline, a clamshell or a locomotive crane.

"PO" OIL ENGINE

The Price Type "PO" Oil Engine, manufactured by the Ingersoll-Rand Company, offers late development in horizontal oil engine design and construction operating on the four stroke cycle.

The satisfactory results obtained with this engine are due to the harmonious design of all its related parts. All of the mechanism is simple and reliable and the engine as a whole is not sensitive nor difficult to maintain.

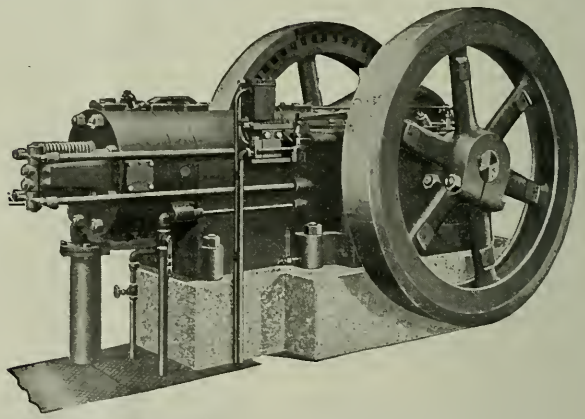
The most outstanding feature of the design is the shape of the combustion chamber and the arrangement and construction of the spray nozzle used for direct-injection of the fuel. Fuel injection and complete atomization are obtained without the use of high pressure air, and ignition by heat of compression only.

Other noteworthy features are the enclosed and oil-tight crank case; the pressure lubrication system for oiling all important bearings, including cam rollers; the continuous filtration of lubricating oil; and the completely water-jacketed cylinder and heads.

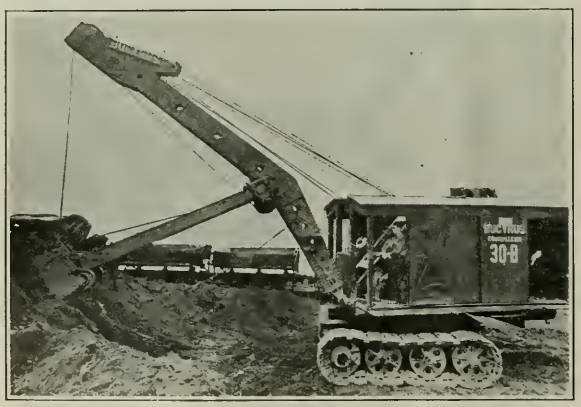
The Price Type "PO" Engine is most economical in the consumption of fuel. Sixteen to seventeen brake horsepower hours are obtained from a gallon of fuel oil. Less floor space is required than with a horizontal engine employing a piston rod, crosshead, crosshead guide and connecting rod. The unbalanced reciprocating forces caused by reciprocating weights are much less with the trunk type engine than in the horizontal engine employing a crosshead. The engine exhaust is invisible. The labor charge is low. Highly skilled operators are unnecessary.

The 100-horsepower engine will run five days of eight hours each, with the expenditure of only one gallon of lubricating oil.

The Price Type "PO" Engine is especially suited for driving direct-current generators, oil or water pumps, air, gas or ammonia compressors, or for belting to line shafts.



INGERSOLL-RAND COMPANY'S PRICE TYPE "PO" OIL ENGINE.



BUCYRUS OIL SHOVEL WITH 55-H. P. DIESEL TYPE ENGINE.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 May 27, 1922 No. 21

American Water Works Convention

More than eight hundred attended the convention at Philadelphia of the American Water Works Association. The meetings were of great interest, and the exhibit was declared to make a finer appearance than ever before.

Although the convention exercises did not begin until Monday evening, when a reception and dance were preceded by the president's address, about 250 active members, 150 associate members and 100 guests had registered by that time; while by Tuesday evening 400 active and 175 associate members had registered and 150 guests. By the end of the convention, Friday, the total had increased to about 800.

In connection with registering, the delegates congratulated Secretary Diven and his wife (nee Miss Edgley) on their marriage last month.

The "ticket" was announced to have been elected and during the coming year W. S. Cramer will be president; George W. Fuller, vice-president; William W. Brush, treasurer; George W. Batchelder, trustee from District No. 1; and Joseph W. Ellms, trustee from District No. 4; while H. F. Huy, R. J. Harding, G. C. Gensheimer and J. Chris Jensen hold over as the other four trustees.

The next convention will meet at Detroit.

TUESDAY'S SESSIONS

The morning session was occupied by the reports of the Publication and Finance Committees, and by a description by George W. Fuller of "The Philadelphia Water Supply, Present and Proposed," with lantern slides; and "Fire Prevention and Fire Protection in Relation to Public Water Supply," in which Frank C. Jordan described the educational campaign waged in Indianapolis by all mediums of publicity. The latter paper was illustrated by samples of window posters, circulars, etc., and was discussed by Gwinn and others.

In the afternoon the history of New York's Catskill water supply, and especially the present work on the Schoharie watershed, were described by J. Waldo Smith, with numerous slides. (This work has been fully described in PUBLIC WORKS.) A description of the Hetch-Hetchy supply for San Francisco had been prepared by the chief engineer, M. M. O'Shaughnessy, but neither he nor his paper were present, but the slides were, and were shown and the account ably given by Prof. Charles Gilman Hyde, drawing on his personal knowledge and having heard Mr. O'Shaughnessy describe the work before the Engineers' Club of San Francisco. The notable features of this work also have been described in PUBLIC WORKS.

Following this was a paper by Wm. A. Megraw describing the design and construction of the Loch Raven dam, both of which contained some unusual features. (This paper we expect to publish in a few weeks.)

In his paper—"Twenty Years' Filtration Practice at Albany, N. Y.," G. E. Willcomb told how, when the original slow sand filters, already almost at the limit of their capacity, became clogged because of unusual sediment and organic content of the river water, sand "scrubbers" were added and worked at 60 million gallons per acre per day. These, of coarse sand, became clogged in turn, and to prevent this alum was used, making them practically rapid sand filters except that the sand was coarser than is customary for these. Even then the slow sand filters became inadequate under winter biological and high consumption conditions, and the effluent of the rapid sand filters was chlorinated and turned directly into the mains. Albany is only 48 per cent. metered, in spite of the urging of the water department. If 100 per cent. metered, the slow filters could again purify all the water, and the reduction in consumption would, it is estimated, pay for the metering in five years.

Discussing this paper, Allen Hazen, the designer of the original plant, stated that the same clogging of its slow sand filters was experienced by Poughkeepsie, N. Y., which uses water from the same river, and by using scrubbers she is able to produce continuously a supply comparable to spring water.

Following this, the members present assembled by geographical districts and elected members of the Nominating Committee, with the following result:

First District.....J. J. Salmond, Toronto
Second District.....J. H. Caldwell, Troy, N. Y.
Third District.....W. R. Edwards, Paterson, N. J.

Fourth District..Dow R. Gwinn, Terre Haute, Ind.
Fifth District.....John Chambers, Louisville, Ky.
Sixth District.....J. J. Hinman, Jr., Iowa City, Ia.

The evening was given over to papers presented to the Water Works Manufacturers' Association. Peter Payne Deane described, with the aid of moving pictures (and a cylinder of compressed air which was allowed to escape at the proper moments to add realism) a test made at the plant of the Public Service Electric Company of New Jersey in closing an 18-inch valve when blowing off high-pressure steam, which was done in less than a minute by Dean control.

Thomas F. Wolfe stated that, from a Pitometer survey of Chicago water mains and leakage, covering 68 miles of mains in 1921, it was found that over 60 per cent. of all leakage was in the service pipes, more than 30 per cent. in fire hydrants and valve stuffing boxes, and less than 7 per cent. in the mains. In fact, the leakage from mains, including all ages, was within the limit usually allowed in testing new mains. From this he believed it an injustice to mains to describe underground leakage as so many gallons per mile of mains or feet of joints; the number of services would apparently be a more logical unit.

"Pneumatic Pumping Up to Date," by John Oliphant, was read by H. C. Sargent in his absence. Some of the later methods of cleaning out wells and opening the soil around the strainers by compressed air, as well as pumping, were described, and illustrated by slides showing Sullivan Machinery Company apparatus.

WEDNESDAY'S SESSIONS

On Wednesday a morning and an evening session were devoted to papers and business, and in the afternoon a trip by boat to Wilmington was given by the courtesy of the Water Works Manufacturers' Association.

At the end of the morning session selection was made of the next place of meeting. The committee reported letter invitations from San Francisco, Los Angeles, Omaha, Detroit, Milwaukee, Trenton, Atlantic City, Washington, D. C., and others. Only three—San Francisco, Omaha and Detroit—were represented by delegates before the convention, and a letter ballot was held on these, with the result of 182 votes for Detroit, 12 for San Francisco and 10 for Omaha.

The morning session opened (on an average between daylight saving and standard time) with the report of the committee on Standard Form of Contract, J. Waldo Smith, chairman. These meetings had been held with representatives of the Architects' and the Railway Engineers' Associations, and a tentative standard form was decided upon to be submitted to the several societies for their consideration. This will be printed in the journal of the association with a view to action upon it next year. Mr. Smith explained that it would seem to be impracticable to secure complete similarity of all contract forms, for laws in different states would necessitate some differences; but the fundamental principles could be standardized. This was accepted as a progress report and the committee continued.

The report of the Standardization Council was then presented by Chairman George W. Fuller. He reported few changes in the personnel of the committees. Several of these were already producing results, especially that on Abstracts, which has for several months been presenting in the journal abstracts of periodic literature. In general, one aim for most of the committees will be to present each year a report on the present status of matters within their respective fields. He hoped that considerable space could be given in the Journal to Council matters. Last year the Council had spent only about $145, but asked for an appropriation of $2,000 for next year. He announced the formation of a Committee on Steel Pipe, with Theo. Liesen as chairman.

At the request of the U. S. Public Health Service, an advisory committee on official water standards had met in Washington Monday and organized, with C. E. A. Winslow, Edward Bartow, and George C. Whipple, all members of the A. W. W. A., as three of the four committee chairmen. The object is to evolve a standard more acceptable for general use than the present interstate standard of the Service; a work which it is not expected to complete in less than two years.

A representative of Secretary Hoover, William A. Durkin, offered the services of the Department in aid of standardization of water works materials.

In a paper, "Industrial Wastes in Relation to Water Supply," Almon A. Fales gave the result of a questionnaire addressed to the health boards of 60 states and Canadian districts, about half of which replied. Only five reported that they had ample power to regulate industrial waste pollution. He described briefly the wastes that gave most trouble to water supplies in each of the states, some of which were coal washing, salt water from oil wells, drainage from rice fields, coke ovens, corn products, pulp mills, woolen mills, dyes, saw mills, munitions factories, tanneries, beet sugar mills, gas works, metal pickling, etc. A list had been obtained of 248 water supplies polluted by trade wastes. In addition to naming the polluting substances and their effects, the report described remedies that had proved more or less successful for most of them (the most common were sedimentation and filtration for suspended matters and aeration for tastes and odors), but stated that much more investigation was needed. He believed that the state boards of health should have more power to control such matters and that the Federal government should investigate the matter thoroughly.

Following this report, Chas. Haydock offered a resolution asking that the Federal government investigate this question and that Congress then enact legislation for controlling trade waste pollution of water. This was strongly opposed by other members who believed the matter was one for state control, but a motion to table it was voted down and the original motion was referred to the Executive Committee.

Mr. Moses, of the Pennsylvania health department, gave some idea of that state's problem, where 138 water supplies are polluted by trade waste, 96 by coal and 15 by by-product coke ovens. None of these can be prevented by the state board unless it prove them to be detrimental to health.

The Watershed Protection Committee, T. D.

Coffin chairman, reported that it considered boating, fishing and bathing in reservoirs dangerous to the supply; advocated reducing trespass to a minimum and patroling the area. A cleared strip around the reservoir should be maintained. Forestry was endorsed. There was apparently no uniformity as to the depth at which water is withdrawn. On certain points the committee was divided, such as whether manure on the shed was detrimental for other than aesthetic reasons. Some believed that the burden placed on purification should be maintained as light as practicable, while one member, W. L. Stevenson of the Pennsylvania Department of Health, stated that he advocated the maximum economy of expenditure of available funds, which often called for reduction of efforts as watershed control when water is purified.

The morning session was concluded by a paper by George R. Taylor entitled "Problems in the Reforestation of Watersheds," in which he described, with the aid of numerous slides, work done in the northeastern part of Pennsylvania. He gave as the most important factor, protection from forest fire, by fire lanes, observation towers, etc. He had found gas tar the best material for destroying vegetation in such lanes; previous to which they grubbed out all the roots and burned the lanes over. They had found white pine the best tree to plant, as it will grow in the shade of underbrush and finally overtop it. Except for this, red pine might be better, as it grows faster and is not attacked by the rust blight as is white pine in New England and northern New York. He advised selecting native trees that would make marketable lumber, but also trying out others for future planting.

(To be continued)

Concreting Long Arch Spans on Short Steel Truss Centers

The highway bridge across the Arkansas river at Fort Smith has fourteen 146-foot and two 212-foot two-rib concrete arch spans (measuring from center to center of piers) which contain in all about 20,000 yards of concrete, including that in the substructure and approaches.

The 146-foot spans were concreted on pairs of steel truss centers, each consisting of two riveted semi-trusses connected with a crown hinge, and by a horizontal member tying the pedestals together. The top chord, curved to conform to the intrados of the arch ribs, supported the 6x8-inch joists and the 2-inch lagging. The trusses were supported on trestle bents bolted to the concrete piers.

In order to make the trussed centers used for the numerous small arches serve for the construction of the two large arches, having spans 66 feet greater, a pair of falsework towers, consisting of three pile bents braced together, were placed 134 feet 9 inches apart on centers symmetrical with the centers of the spans, and the semi-trusses, braced together in sets of three, were assembled in horizontal position on falsework at the springing line and were successively revolved around their skew-back bearings into service position by means of two 8-part tackles with their lead lines carried over the top of a 35-foot shear bent and simultaneously operated by a double drum hoisting engine. These tackles supported both sets of semi-trusses in position until they had been connected together by the crown pins and became self-supporting, after which pony bents of timber falsework were erected on their top chords to support timbers parallel to the intrados of the arch that carried the joists and lagging. At each end of the span there were erected two additional panels of falsework, made with one pile bent and one framed bent, the latter supported on and bolted to the concrete pier. These bents were capped at skewback level and carried vertical and diagonal posts supporting the arch forms from the ends of the steel trusses to the concrete piers. In this way one set of steel center trusses was made to suffice for both long and short spans. Hedrick & Hedrick, Kansas City, Mo., are the engineers and the Missouri Valley Bridge & Iron Company is the contractor.

Philadelphia Sesqui-Centennial Exposition Preliminary Report

A committee of thirty-four prominent members of the Engineers' Club of Philadelphia, with representatives of the Real Estate Board of Philadelphia and the American Institute of Architects has presented to the president and members of the executive committee of the Sesqui-Centennial Exhibition Association a comprehensive report recommending Fairmount Park and a portion of the Parkway as the site region of approximately 2,100 acres for the selection of 600 acres required for the proposed exposition in 1926, which it is estimated will involve a gross outlay probably in excess of $30,000,000.

The site was recommended on account of its accessibility, its adaptability for the creation of a World's Fair development of surpassing beauty, and the possibility of the construction and use of buildings which will be of large permanent value to the city after the fair is over.

The site was recommended after a careful consideration and study of twelve other sites, including the lower and the upper Fairmount Park sites in the same region, the Pennypack Park, Roxborough plan, lower Roosevelt Boulevard and the Juniata and Tacony Park plans in the northern region, and League Island Park, Hog Island, Cannonball Farm, the United States Shipping Board and the Fortieth Ward plans in the southern region.

A consideration of the present and probable future local population and the study of previous World Fairs determined the provision for the daily attendance of from 75,000 to 400,000 visitors for a period of 200 days.

It was estimated that eighteen great exhibit buildings, a stadium, and amusement buildings requiring 100 acres, and auxiliaries requiring 50 acres more would be needed.

The various requirements and installations were thoroughly studied and compared by subcommittees on Statistics, Civil Engineering, Transportation, Power and Light, Central Service Station, Communication, Liaison with the Philadelphia Real Estate Board and the Philadelphia Chapter of the American Institute of Architects, Public Information, Scope, and Correlation. An executive commit-

tee, including the subcommittee chairmen, had general supervision.

Each subcommittee gave thorough study to the portions of the project assigned to it, placing, where this was possible, numerical weights upon each element for the several sites, in order that accurate comparisons might be made, and followed this detailed study by a careful summation of its findings. The subcommittee reports having to do with divisions of the work were carefully considered by the Correlation Committee, which was composed of subcommittee chairmen, and after weighing the data and information at hand the findings were determined upon.

State Highway Maintenance in Massachusetts

Roads Built by Town Forces Under State Direction. Organization of Engineering Force. Reports Submitted by Superintendents. Equipment of a District for Making Repairs and Maintenance.

The state of Massachusetts, about 190 miles long and 110 miles wide, has an area of 8,039 square miles, a population of about 4,000,000 and an assessed realty valuation of about $5,000,000,000. The highways having a total mileage of about 23,000, including about 5,000 miles of city streets and 1,500 miles of roads the construction and maintenance of which has been under state control for about 28 years. These latter roads are now under control of a department organized in 1919 when it was made a division of the Department of Public Works under commissioner John N. Cole and associate commissioners F. B. Kemp and J. W. Synan, chief engineer A. W. Dean, construction engineer F. C. Pilsbury, and Bridge engineer W. S. Williams. The state is divided geographically into seven dictricts, for which the construction engineers are respectively: G. A. Curtis, at Pittsfield; H. G. Phillips, at Greenfield; J. A. Johnston, at Springfield; F. E. Sabin, at Boston; D. H. Dickinson, at Beverley; R. W. Coburn, at Brookline; and George Delano, at Middlebrook.

The sizes of the districts vary according to their location, topography, character of population and other considerations that determine the area that can most advantageously be handled by the district organization. For example, district No. 2, about 40 miles wide and 50 miles long, has an area of about 1,600 square miles, a real estate valuation of about $110,000,000 and a population of 118,000. It contains 170 miles of state highways of which 90 per cent. are of bituminous macadam and the remainder of gravel, excepting five miles of concrete. There are also 1,800 miles of "Chapter 155 Roads" (town roads that are not state roads, but that are under state supervision). In 1921 about fifteen miles of additional small town roads were constructed in this district and five miles of existing roads were reconstructed with concrete pavements.

Important new construction is chiefly done by contract let under competitive bids, but the small town roads, mostly of gravel construction, costing at present prices from $10,000 to $15,000 per mile, are principally built by the town forces and at town expense under state direction. The towns, however, are aided by the state in accordance with their property valuations, the state generally furnishing an amount equal to that raised by the town. The district engineer's forces execute repairs and maintenance except the light oiling with an application of tar or of 60 per cent. asphaltic oil, which in 1921 was done in district No. 2 by contract for a price of about $35,000, which covered 100 miles of road.

In district No. 2 there are six principal assistant engineers in the office and five construction engineers in the field, each of them directing about three assistants. There are two superintendents of maintenance for chapter 155 work, two three-man survey parties, two stenographers, and an average from 75 to 150 men in the maintenance crews. The district is equipped with twelve 2-ton Army Quad, International, Peerless, and Pierce Arrow trucks, and two Buffalo-Pitt rollers and scarifiers. The fifteen foremen are provided with 2-ton trucks, and each of them has a Ford car in which he patrols all the roads in his section and performs all of the maintenance required as he observes the necessity for it, completing the work with about ten men that maintain the surface and gutters in condition, trim the trees, look after guard rails, etc. He reports daily to the maintenance engineers, who visit every part of the line weekly. These gangs do all the necessary cold patching, material for which, together with field stone, cement and 1½-inch broken stone, are stored at convenient intervals. In 1921 these gangs did an estimated amount of about $100,000 worth of work in district No. 2.

The weekly reports of the district superintendent are made on blank forms 8½ inches wide and 11 inches long, dated, signed and filed in the department of public works at Boston. The same blanks are used for the reports of the superintendents of maintenance. These blanks are headed "Weekly Report of District Superintendent." "Section 26, Chapter 81, General Laws," and have the following column headings: "Towns visited this week." "Is the work progressing satisfactorily?" "Are pay rolls and daily report cards being made out properly?" "Under this column state general nature of work being done, local conditions, or other pertinent facts."

These blanks are headed: "No....." "Town of....." "Payroll on ..... (Road or Street)." "For period beginning ....., 19...., and ending ..... 19...., both inclusive, on account of Contract No. ..... with the Dept. of Public Works, Div. of Highways, under Chapter ....., Acts of 19...." The seven columns are headed as follows: "Name." "Classification." "Time [Day—Hrs.]." "Rate." Amount." "We, the undersigned, acknowledge to have received the sums set against our respective signatures. (If signatures are not obtained show number of check drawn for payment of each item.)" At the foot of the blank are given "Approve for ....." "Paid by check No. ....." "Department approval ..... (title)." Accounting approval ..... (title)."

The pay rolls are made out on sheets of the same size, each of which is ruled and numbered for 20 employees, who are required to sign their names.

All material required for work done under Chapter 155 is requisitioned on blanks, signed by the state's foreman and by the chairman of the selectmen of the town where the work is done. The summary of labor and materials for each job is recorded on a printed form of postal card size and daily forwarded to the district engineer. These blanks are headed "No....," "Town of....," "Payroll on .....(Rroad or Street)." "For period beginning .....19.., and ending.....19.., both inclusive, on account of Contract No.... with the Dept. of Public Works, Div. of Highways under Chapter...., Acts of 19..." The seven columns are headed as follows: "Name," "Classification," "Time [Days—Hrs.]," "Rate," "Amount." "We, the undersigned, acknowledge to have received the sums set against our respective signatiures. (If signatures are not obtained, show number of check drawn for payment of each item.)." At the foot of the blank are given "Approved for $....." Paid by check No...." "Departmental approval.....(Title)." Accounting approval.....(Title)."

All work done in the district is summarized in the engineer's weekly progress record that is submitted to the Boston office and there posted so that the conditions of all work throughout the state can be quickly determined at any time by inspection of the progress diagrams on which the different classes of work are indicated by conventions.

Chapter 155, general act of 1918, general laws of Massachusetts, is an act to provide for the improvement and repair of highways in small towns. It provides for repair and improvement of public ways, exclusive of state highways, in towns of which the valuation is less than $3,000,000, and in which this sum divided by the mileage of such ways (known as mileage valuation) is less than $50,000; state to appropriate not more than $50 a mile, provided town appropriates $12.50 per mile if its mileage valuation is less than $5,000, and proportionate sums up to $125 if the mileage valuation is between $40,000 and $50,000. These sums are to be expended under the direction of the State Highway Commission on roads agreed upon by it and the town selectmen upon petition of the latter; but not upon any roads where dwellings or business houses average more than 200 feet apart for a distance of a quarter of a mile. The state appropriations are drawn from the motor vehicle fees fund.

The petitions for road work are usually granted by the Department of Public Works and the latter then executes with the board of selectmen of the town an agreement for the execution of work of the specified value that provides for the designated roads or portions of roads to be widened, reshaped, or surfaced with gravel or other materials and that the brush shall be cut, culverts and catch basins built and stone filling furnished in place, and road scrapers and road drags used for maintenance.

It further provides that the work shall be done at such times and in such manner as directed by the engineer, and that no materials, supplies, machinery or tools shall be purchased for said work without his consent. Some labor requirements and regulations are specified and it is required that reports, payrolls and the like shall be submited daily on specified forms.

On the completion of the work to the satisfaction of the Department of Public Works, or at intervals before its completion, the Department of Public Works agrees to pay to the town a certain percentage of the cost of work done and of the actual cost of materials and labor furnished as shown by the reports, this sum being not in excess of the agreed allotment.

In district No. 2 allotments are usually granted to about 35 towns, after which the district engineer or or his representative confers with the selectmen and

SUMMARY OF ANNUAL COST OF MAINTENANCE. AVERAGE FOR THE YEARS 1913 TO 1920 INCLUSIVE.

Costs per mile (11,000 sq. yds.) for foundation and surface only, not including grading, drainage, etc., with annual "Surface Maintenance" for typical state roads in Massachusetts. Stone foundation figured as 8 in. thick under bitumenized surfaces (except Chicopee asphalt mix reinforced with total 3½ in. depth stone and top) but with no foundation figured under concrete. As the cost of grading would be the same with any type of surfacing, but varies with localities, it is not included in above comparative figures. Present costs of construction are about double the above.

	Water Bound Mac.		Asphalt Mix.		Asphalt Penetration		Concrete		Gravel (Oiled)		Tar Macadam Johnston Process	
	Per Mi.	Sq. Yd.	Per Mi.	Sq. Yd.	Per Mi.	Sq. Yd.	Per Mi.	Sq. Yd.	Per Mi.	Sq. Yd.	Per Mi.	Sq. Yd.
Expenditure	484.90	0.044	147.86	0.013	92.21	0.008	39.24	0.003	320.54	0.029	145.98	0.013
Interest at 4%	435.56	0.040	644.69	0.059	492.18	0.045	581.63	0.053	244.64	0.022	340.53	0.031
Total	920.46	0.034	792.55	0.072	584.39	0.053	620.87	0.056	565.18	0.051	486.51	0.044

The Commonwealth of Massachusetts
DEPARTMENT OF PUBLIC WORKS
Division of Highways
District Engineer's Weekly Progress Record

Town	Act	Prel'y Report Plans Rec'd.	Prel'y Report Report sent.	Allotment Made	Allotment Amount	Contract Work Signed	Contract Work Started	Engr.	Per Cent. Done Surface	Per Cent. Done Value	Date Comp.	Date Accepted
Leverett	155	....	5-5-21	3-23-21	$39.50	....	....	C.B.R.	50	50	....	....
Leyden	155	....	5-4-21	4-13-21	30.50	'21	....	E.C.V.	..	..	....	....
Middlefield ...	155	....	5-27-21	4-23-21	34.00	'21	....	W.T.M.	..	..	....	....

prepares a budget and classification and location of work for the current year, which is executed by the selectmen under the supervision of the district engineer. The work on dirt roads consists chiefly of dragging, scraping, cutting brush, widening the roads, opening waterways and culverts, repairing mud holes, building short lengths of gravel roads putting in stone foundations and the like, and averages from $75 to $80 per mile per year.

In 1894 the state of Massachusetts commenced the construction, development and maintenance of the better highways and up to 1921 had expended on their maintenance $10,000,000, exclusive of the much larger sum expended by cities. During the same period contributions from motor vehicles to the road fund were about $10,000,000. A larger proportion of the earlier improved roads of Massachusetts were waterbound macadam costing in the neighborhood of $6,800 per mile and involving a heavy maintenance cost. They were unsuited to motor vehicle travel and in the most important primary roads are being replaced to a considerable extent by concrete, costing from $50,000 to $60,000 per mile, but involving a very small maintenance charge and providing for almost unlimited amount and speed of traffic, which have contributed to road construction and increasing revenue, amounting in 1920 to about $3,000,000, per year.

The programme of the state highway department for the next two years provides for the expenditure of not less than $90,000,000 for road construction, maintenance and improvements, including $20,000,000 for maintenance and a certain amount of development on 200 miles of important secondary highways, and exclusive of at least $20,000,000 that must be raised by the state, counties and towns for the renewal of bridges.

A tabulation has been prepared by district engineer J. H. Johnston for fourteen towns for the years 1913-20, inclusive, for the principal types of improved roads. From this he prepared a summary giving for each type the average annual cost of maintenance, including interest at 4 per cent. on original construction costs. This indicates that tar macadam is the cheapest and water-bound macadam the most expensive.

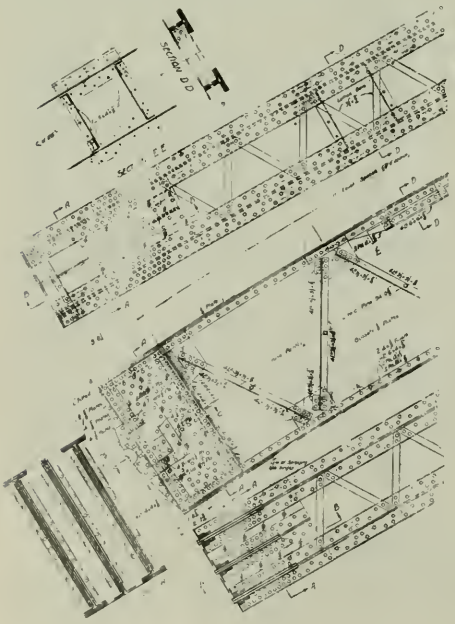
Springfield—West Springfield Bridge

Description of the River Spans, Roadway and Viaduct. Organization Responsible for the Work.

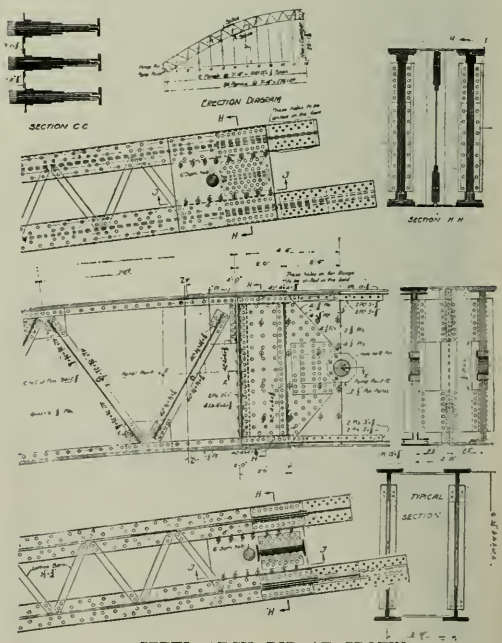
RIVER SPANS.

The river portion of the bridge consists of seven spans, varying in length, having, with their piers, a combined length of 1,192 feet. Each span carries a floor platform 80 feet wide, on spandrel columns and walls supported by five 2-hinged segmental reinforced concrete arch ribs, which, for the channel span, have a span of 176 feet and a rise of 29.71. The other spans have lengths varying from 154 to 110 feet and rises varying from 29.2 to 19.1 feet.

*Continued from page 368.



END OF ARCH REINFORCEMENT STEEL RIB.



STEEL ARCH RIB AT CROWN.

The rib concrete immediately adjacent to the steel hinges is proportioned one part Portland cement to a total of not more than 4½ parts of fine and coarse aggregate, the coarse aggregate being such as will pass through a ¾-inch diameter ring. The main part of the outside ribs and their spandrel walls are proportioned one part Portland cement to not more than 5½ parts of coarse and fine aggregate. For the three inner ribs the concrete is proportioned one part Portland cement to 6 parts of fine and coarse aggregate, the coarse aggregate being such as will pass through a 1½-inch diameter ring.

Concrete for the sidewalk slabs is proportioned one part Portland cement to a total of not more than five parts of fine and coarse aggregate passing a ½-inch diameter ring.

All of the arch ribs have uniform rectangular radial cross sections 5 feet 6 inches wide by from 4 feet 9 inches to 7 feet high, and are reinforced by pairs of structural steel riveted arch ribs with their top and bottom chords latticed together and by anchor bars embedded in the concrete near its outer surface.

The steel ribs were shipped to the site in quarter rib sections and were erected in half or quarter sections, the quarter point splices being made in the field. The hinge pins at crown and haunches vary from 6 to 8 inches in diameter.

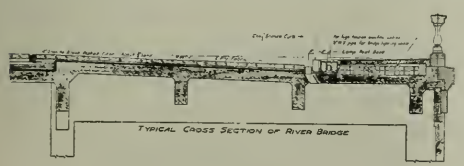
The skewback pedestals are of cast steel with full length bearings for the hinge pins. The ribs contain 2,100 tons of structural and cast steel and about 6,000 yards of concrete.

ROADWAY.

The floor slab is supported on reinforced concrete stringers and transverse girders and is provided with transverse expansion joints that, in the roadway, are covered by the horizontal flanges of transverse T-bars with their vertical webs projecting down into the joint. The sidewalk joints are made with a transverse vertical plate having its lower end sliding on the horizontal leg of an angle covering the joint.

The roadway is paved with granite blocks, having asphalt filler and set on a sand cushion over a layer of waterproofing on the upper surface of the slab. The pavement and sidewalks are separated by the granite curbs and the former is drained through cast iron scuppers. The sand cushion under the pavement is drained through openings under the caps of small vertical cast iron pipes adjacent to the curb.

The beacon towers at the extremities of the channel span have hollow reinforced concrete shafts about 68 feet high, surmounted by bronze and glass lanterns and faced with artificial stone. At the base the cross section is 8-sided with an external diameter of about 7½ feet and an octagonal interior wall, 6 feet in diameter. The circular shaft above the pedestal is about 50 feet high with exterior diameters of 7 feet 4 inches and 6 feet at the base and at the top, and a uniform interior diameter of 3 feet 4 inches. The small towers are octagonal in cross section and are 5 feet 8 inches in diameter at the base, tapering to 2 feet 7 inches at the top, where they are surmounted by bronze spheres. They are made of concrete faced with artificial stone.

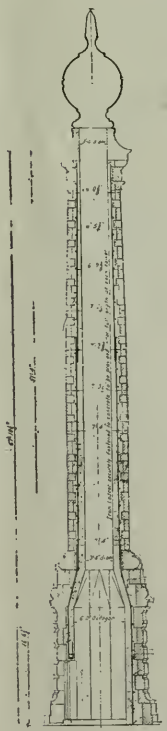


PART SECTION OF ROADWAY IN ARCH SPAN.

VIADUCT.

That portion of the bridge east of the river is termed the viaduct and consists of a reinforced concrete slab suported on piers and columns, some of which are carried on the shore end of the river abutment and some of which have concrete pile foundations because the ground water level is not high enough to insure the upper part of wooden piles against decay. There are 389 precast concrete piles of about 8 inches square cross section at the point and 14 inches square cross section at the top, with an average length of 24 feet, which were made of concrete proportioned one part Portland cement to not more than six parts of fine coarse aggregate, passing a ¾-inch diameter ring.

The reinforced concrete slab is 82 feet 6 inches wide from out to out and for a width of 19 feet in the center, where the surface is depressed 9¼ inches to receive the ballast for the railroad tracks, has a thickness of 30 inches. The floor slab is supported on transverse bents of structural steel or reinforced concrete 31 feet apart in the clear. Each steel bent has four vertical steel columns with H-shape cross sections made with a solid web plate and two channels having their flanges turned inward. The tops of the steel columns are connected by transverse plate girders 4 feet deep, and both columns and girders are enclosed in a solid mass of concrete anchored thoroughly to the steel work.



BEACON TOWER

ORGANIZATION.

The bridge was authorized by the supreme judicial court of Massachusetts acting through a special bridge commission, consisting of Hon. J. L. Bates, Hon. J. H. O'Neal and J. R. Worcester, Esq., with counsel. The designing and supervising engineers are Fay, Spofford & Thorndike, of Boston, with Haven & Hoyt, of Boston, as advisory architects. The construction contracts were awarded as follows: Bridge over river and railroad, to H. P. Converse & Co.; Springfield approach (part), to Daniel O'Connell's Sons; track work on bridge, to H. P. Converse & Co.; West Springfield approach (part), to Geo. W. Hayden. The contracts for surfacing the West Springfield approach and removing the old toll bridge have not yet been awarded. The sub-

contractors under H. P. Converse & Co. were: structural steel, McClintic Marshall Co.; granite, Cape Ann Granite Corp.; sand and crushed stone, Holyoke St. Ry Co.; artificial stone, Simbroco Stone Co.

The principal quantities involved are: Dredging 110,000 yards; wooden piles for foundations 10,500; concrete viaduct piles, 389; concrete 54,000 yards, requiring cement 71,600 barrels, sand 24,700 yards and stone 49,100 yards; granite, 4,700 yards; structural and cast steel, etc. 2,300 tons; reinforcing steel, 1,260 tons; artificial stone, 1,135 yards; waterproofing, 9,970 yards; paving blocks, 300,000; curb, 3,000 feet; ducts, 89,640 feet; lumber, 2,931 M feet b.m.

Engineers' Plans for State Health Boards*

Regulations of the State Boards of Kansas, Kentucky, Louisiana, Maine and Maryland, with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits.

KANSAS (Continued): *Sewerage*—Map to show all sewers, with sizes, and appurtenances. Scale not smaller than 300 ft. to 1 in.

Profiles of all sewers, elevations at manholes, grades between manholes, at outlet, bed of stream, ordinary and high water. Scale suggested, 10 ft. to 1 in. vertical; 100 ft. to 1 in. horizontal. Detail drawings of all appurtenances, and of sewers other than vitrified clay.

Plans for disposal plant shall include general layout and longitudinal and transverse sections of each unit. Details of baffles, overflows and other devices; depth and sizes of filtering media, methods of collection and distribution of sewage.

Engineer's report to discuss area to be sewered, population now and 25 years hence, estimated per capita flow, infiltration, character of sewage, method of flushing or cleaning, minimum and maximum grades, areas not drainable into system, distance of buildings from outlet or treatment plant, maximum and minimum flow of stream receiving sewage, drainage area above outlet, nearest water supply taken from stream below outlet, method of disposal, rate of working, nature of receiving body of water, disposal of sludge, results expected from plant, maintenance and operation.

Kentucky—"All that is required are plans and specifications in duplicate and a report of the data used in the design."

Louisiana—The regulations are practically the same as for Arkansas, some of the differences are, that plans for disinfecting plant are not always required. There is added under "Information Concerning Purification Plant," the sentence: "If for purposes of fire protection it is necessary to provide by-passes, by which partly treated or raw water can be turned into the mains, they shall have valves upon them of such a character that they may be properly sealed by the State Board of Health."

Maine—"The commission has issued no rules or regulations governing the filing of plans by water companies, water districts or municipalities installing sewerage systems."

Maryland—All plans must be drawn with black ink on tracing cloth or other paper such that copies can be made, and copies in duplicate sent to the State Board of Health, one for its main office, the other for the Board's resident engineer. It is urged that plans have, as outside measurements, 15x21, 21x30, 30x42, or 11 in. high by from 8½ to 18 in. long. Larger plans may be 42x60 or 60x84 in., so that they can be folded to 30x42 in. size. If an engineer has office standards different from these, he is requested to submit sizes smaller rather than larger than the above. "No long profiles will be accepted. Plans not drawn up in observance of the above rule will be returned for revision."

General plans of water or sewer mains shall be drawn to a scale between 40 feet and 200 feet to one inch. Each drawing shall have a title in the lower right hand corner. In general, the maps and plans are to contain the information called for by the Arkansas regulations. "Elevations of high and low water in the reservoirs shall be indicated, and also the location and elevation of all intakes and valves." There shall be furnished a profile along the supply line from the source to the distribution system. For dams, complete detail plans of all features must be submitted; also for purification plants; and of all wells, connecting piping, valves, pumping stations, etc. "Information as to water consumption, population served, and number of services, must be submitted with the plans" of existing systems.

The engineer's report shall "contain full information concerning the system in all its features, the estimated cost, the area and population which the system is designed to serve, the estimated water consumption, the estimated yield of the sources of supply, full information concerning the pumping equipment if any, a description of and complete data concerning the purification plants if any, including the rate of operation, the kinds and amounts of chemicals to be used, a description of the character of the water and reasons for treatment, and in case by-passes have been provided, the reasons therefor."

Mains less than 6 in. diameter are not favored, and will not be approved for feeding fire hydrants.

While the Board has no hard and fast rules relating to purification of water supplies, "in general, it may be said that no surface water supplies in this State are entirely safe without treatment of some kind." The kind of treatment depends upon the physical and sanitary quality of the water; with some water mere disinfection may be satisfactory; "in general, however, turbidity, color, and grossness of pollution will make it advisable that a filter plant be installed—unless the location of water supplies from underground sources is chosen with great care, it is not unlikely that disinfection will be found necessary." *(To be continued)*

*Continued from page 375.

PUBLIC WORKS

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A National Department of Public Works

The design, construction and maintenance of federal highways, bridges buildings, canals, docks, dams, river and harbor improvements, and other civil and military federal constructions are now distributed among many departments and bureaus, administered at best with conflicting interests and actually subject to great overlapping, interference, and incompetence without adequate preparation or equipment, necessarily involving great delay, unnecessary complications, and high cost.

This system has therefore resulted in enormous duplication of work, perpetuation of mistakes, lack of standardization, dissemination of resources, duplication of equipment, political interference, departmental jealousies, inefficiency, extravagance, and unnecessarily elaborate and costly burden on the taxpayers.

All of these disadvantages might be largely eliminated and a high degree of efficiency and economy be secured by grouping all the construction operations in a single federal department headed by a cabinet officer and conducted on strictly business and economic principles that would co-ordinate all of the interests involved, establish uniformity of standards and operations, develop a highly specialized corps of officials and employees. This would effect a great saving of time and money, insure vastly improved results, and directly exert an enormous influence in advancing construction methods and appliances for the benefit of private and corporate interests throughout the country.

The establishment of such a national department to co-ordinate the interfering and conflicting interests has long been urged, especially by eminent civil engineers. During the war a great impetus was given to the idea, and the problems developed in the Quartermaster's Department for the construction of camps, cantonments and other great building operations under most adverse conditions emphasized the enormous advantage of such a well organized department, which was heartily endorsed and publicly advocated by General R. C. Marshall, Jr., then engineer in charge of construction and now general manager of the Associated General Contractors of America.

President Harding has also endorsed this plan which is favored by Secretary Hoover, but its hopes of success are seriously menaced by political opposition and unworthy departmental jealousies.

In view of these conditions, the American Engineering Council of the Federated American Engineering Societies has just made an announcement that the engineers of the nation will start a national movement for the establishment of a national department of public works. The question will come up for active consideration at a meeting of the Executive Board of the Council at Pittsburgh, May 26th, and it should be vigorously supported by the Board as well as by engineers, contractors and officials generally throughout the country. Probably no other public improvement has such potentiality for advantage to construction interests.

Costly Municipal Policy

The development of New York's tunnel and railway system involves four great factors which should be thoroughly coordinated: the City of New York, the twelve trunk railroad lines transporting freight to and from the port, a Public Service Commission responsible for rapid transit facilities, and the port authorities which were chosen by the legislatures of the States of New York and New Jersey to promote the best interests of foreign and domestic commerce and industry at this point.

Consideration has to be given to 105 municipalities, twelve trunk line railroads transporting 75,000,000 tons of products annually, steamship lines handling 45,000,000 tons annually and a population of 8,000,000 people within the limits of the local district. There are also more than 800 miles of available shore line in Manhattan Island, Staten Island and the adjacent shores of Long Island and New Jersey and an elaborate network of surface, subway, elevated, passenger and freight lines, different terminals and warehouse districts, and private, municipal and railroad piers that combine to make the problem very complicated.

Its solution should be in the line of a harmonious and progressive plan providing the greatest economy, efficiency and ultimate scope with due consideration of the national and state as well as the municipal

features. It will eventually involve the spending of hundreds of millions of dollars for the benefit of thousands of millions of dollars of business.

For many years, different plans have been studied and considerable money spent in investigations and preliminary estimates and reports. Among the most prominent are those directed by the Public Service Commission and by the Board of Estimate and Apportionment of New York and by the Port Authority. The Public Service Commission plan was chiefly concerned with a tunnel from the borough of Manhattan to that of Richmond, under the narrows of New York Harbor and a considerable amount of data accumulated for it was turned over to the Board of Estimate and Apportionment after legislation had been enacted authorizing the mandatory construction of such a tunnel by the City of New York.

Under date of October 15, 1921, the engineer employed by the Board reported in favor of two twin tunnels under the narrows at an estimated cost of $51,000,000. It was proposed to make this tunnel a link in a loop enclosing a portion of Staten Island and a large area in New Jersey. The outlines and location of this loop considerably resemble those of a system proposed by the Port Authority, although the latter was more extensive and had additional service lines for Manhattan Island and extending to Brooklyn, but without any connection between Brooklyn and Staten Island. The proponements of either plan would not except the other plan, and all but one of the railroads refused to accept the Board of Estimate plan.

The Board of Estimate has, therefore, adopted a new plan for two freight and rapid transit passenger tunnel tubes under the narrows from Brooklyn to New York involving five and one-half miles of tunnel and an approximate cost of $60,000,000, for which an appropriation of $4,000,000 has been made to commence operations and to perfect the scheme which it is hoped some of the railroads will accept. Most of the railroads have announced that they will consider no tunnel except one under the Upper Bay such as the Port Authority contemplates from Brooklyn to New Jersey. It is problematical whether the narrows tunnel can be successful commercially and its construction now is likely to be a serious diversion of funds and increase of the taxpayer's burden, and be an obstruction to the broadest and most profitable developments of the great national port which is provided for by the special Port Authority with which all such projects should be completely harmonized rather than defiantly or adversely exploited.

Improved Financial Condition of Water Works*

By Leonard Metcalf‡

Data have been submitted to this Association at previous conventions to show the effect upon the expenses and net revenues of water works in the United States, of the higher costs and lesser efficiencies resulting from war conditions. The first report was presented in 1918 under the title, "War Burdens of Water Works in the United States," and extensions of the data to cover later periods were submitted in 1919 and 1920. The present paper extends the data to include the records of the years 1920 and 1921, the figures having been furnished, as in previous cases, through the courtesy of the managers of the plants covered by the reports.

The data submitted herein for the years 1920 and 1921 do not cover precisely the same plants but they are practically the same to all intents and purposes. The records of about forty-five plants, both publicly and privately owned, are included in the present tabulation, serving a gross population of 9,000,000 in the year 1920, as compared with about fifty plants, serving approximately the same total population, covered by the earlier reports.

The records indicate that, speaking in general terms, the water works of the country are past the period of acute distress due to the war, and that their revenues available for depreciation, interest, dividends and surplus, are approaching what would have constituted a normal basis *under pre-war conditions,* but they have not yet reached the higher level corresponding to post-war conditions, nor have they been permitted to make good the cumulative losses of the war period, nor has it been possible for them to make the deferred betterments to adequately meet the growing demands of the service. The results accomplished have been attained in part by increasing the rates charged customers, in part by natural growth, in part by increasing efficiency and decreasing cost of operation as the effects of the war have been gradually overcome, and in part by deferred maintenance and deferred betterments, and an undesirable reduction in margins of safety.

In table 1 is shown a summary of data upon changes in cost of unskilled labor and of materials used in the construction, maintenance and operation of water works from 1915 to 1921. The cost of contract labor, such as ordinarily used in construction was of course much higher during the war period than that of the permanently employed labor used in maintenance and operation. It is to be borne in mind, too, that the maximum reduction in efficiency was probably at least fifty per cent at the peak or worst period.

LABOR COSTS

The cost of unskilled labor reached its peak shortly after the presentation of the last report to

*Paper presented before the American Water Works Association at its Philadelphia convention, May 16, 1922.

‡Of Metcalf and Eddy, consulting engineers, Boston, Mass.

the 1920 Convention, the average cost to all works reporting, for the year 1920, being 50 cents per hour, while the average cost in 1921 was 43.5 cents per hour, and the present average rate is probably about 40 cents. The average price for 1920 represented an increase of 123 per cent over pre-war (1915) prices; the average for 1921, 94 per cent in excess of the 1915 prices,—both without allowance for decline in efficiency or output.

The increase in efficiency of labor has probably been somewhat more pronounced than the reduction in price,—the efficiency or output has returned from 50 per cent below normal, to normal, broadly speaking.

CAST-IRON PIPE PRICES

When the last report was made to this Association, two years ago, prices of cast-iron pipe were practically three times normal pre-war prices. In 1920 they rose somewhat further. The average for 1921 was a little more than twice pre-war prices, and at the present time the price is probably a little less than twice that which prevailed before the war. It appears to be abnormally high still and out of line with pig-iron and steel prices and with the price level of other manufactured products as well as of labor, seriously retarding the betterment of water works.

THE PRICES OF VALVES AND HYDRANTS

These never reached so high a plane during the war as that of other materials, but continued to rise in 1920 and receded in 1921 to a figure somewhat higher than that which prevailed in 1919. The fluctuations were much less marked than were those noted in the case of cast-iron pipe.

It may be of interest to compare with the percentage increases in cost of unskilled labor and materials to water works, over pre-war basis, shown in Table 1, the percentage increases during the period from 1916 to 1921, indicated by the index numbers of various agencies shown below.

Year	U.S. Dept. Agriculture Per Cent	Dun's Per Cent	Bradstreet's Per Cent	Eng. News-Record Per Cent
1916	24	21	30	47
1917	76	67	72	81
1918	96	87	106	89
1919	114	88	105	99
1920	144	102	107	151
1921	55	39	25	102
Average for six years	85	67	74	93

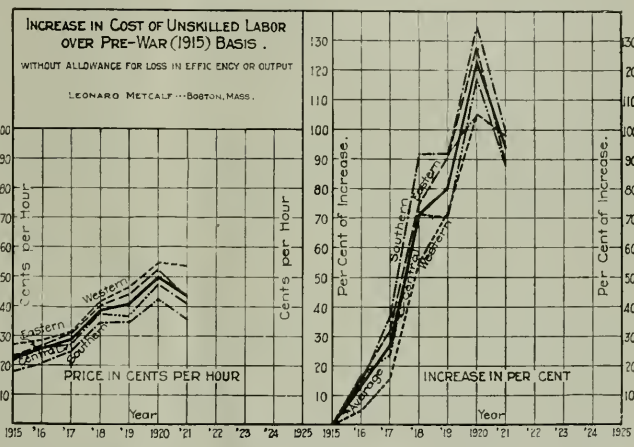


Table 1.—Summary of Data upon Increase in Cost of Unskilled Labor and Materials to Water Works in the United States, from Pre-war Basis (Characterized by 1915 costs) up to 1921.

Item	Number of Records on Different Years	Prices Per Unit 1915	1916	1917	1918	1919	1920	1921	(Pre-War Basis) Per Cent Increase Over 1915 1916	1917	1918	1919	1920	1921
1. Unskilled labor in cents per hour														
(a) Eastern Group	15-18	23.0c	26.7c	30.4c	40.2c	43.8c	52.5c	43.4c	16	32	75	91	128	87
(b) Central Group	17-12	21.7c	25.3c	26.9c	37.2c	36.8c	47.1c	40.9c	17	24	71	70	117	88
(c) Southern Group	6-12	17.9c	20.6c	34.5c	34.3c	34.4c	42.1c	35.7c	15	37	92	92	135	99
(d) Western Group	7- 8	27.0c	28.5c	31.4c	41.8c	46.4c	54.7c	53.5c	5	16	55	72	105	98
(e) Average of Groups	.....	22.4c	25.3c	28.3c	38.4c	40.4c	50.0c	43.5c	13	27	71	80	123	94
2. Cast iron pipe per 2,000 pounds approximately	17-44	$24.23	$30.70	$51.60	$67.74	$69.20	*$76.53	$52.30	27	113	179	184	216	116
3. 6" valves	11-40	11.18	12.64	19.13	19.13	20.73	24.72	21.93	13	71	71	85	121	96
4. 12" valves	3-38	34.78	41.53	65.22	65.62	59.66	68.90	62.13	19	88	87	72	98	79
5. 2-way hydrants	6-38	26.69	32.04	43.13	51.80	47.16	52.30	47.10	20	62	94	77	96	77
6. Coal per 2,000 pounds														
(a) Eastern Group	13-15	$2.98	$3.80	$5.96	$6.60	$5.41	$7.34	$5.81	27	100	101	82	146	95
(b) Central Group	8-12	2.41	2.77	3.75	4.53	4.55	5.84	5.69	15	56	88	89	142	136
(c) Southern Group	7-12	1.92	2.01	3.03	3.89	3.78	5.35	4.45	5	58	102	97	179	132
(d) Western Group†	5- 4	3.97	4.37	6.31	7.92	4.70	5.60	5.29	10	59	99	18†	41	33
(e) Average of Groups	.....	$2.82	$3.24	$4.77	$5.57	$4.61	$6.22	$5.43	15	69	97	63	121	92
7. Fuel oil in cents per gallon, South	1- 3	1.80c	1.80c	2.00c	4.28c	.....	2.35	2.93	0	11	138	..	30	62
Fuel oil in cents per gallon, West	1- 4	1.38c	1.50c	2.57c	4.05c	4.00c	4.16	4.16	9	86	193	197	201	201
8. Alum, per pound														
(a) Eastern Group	.....	1.12c	1.72c	1.48c	1.45c	1.66c	1.90	1.75	54	33	29	48	69	57
(b) Central Group	.....	0.91c	0.91c	1.25c	1.50c	1.40c	2.66	1.86	0	37	65	54	192	104
(c) Southern Group	.....	1.08c	1.38c	1.38c	1.78c	1.56c	2.17	1.81	28	37	65	44	101	67
(d) Western Group	.....	1.14c	1.21c	1.51c	1.53c	1.79c	2.04	2.23	6	32	34	57	79	96
(e) Average of Groups	.....	1.06c	1.30c	1.43c	1.56c	1.60c	2.21	1.84	22	35	47	51	108	73

*Range $50.60 to $83.50 per ton. †Small number makes record of doubtful value.

In the case of the U. S. Department of Agriculture figures the pre-war price basis is determined by that for the year 1915; for Dun's and Bradstreet's indices, the average of years 1912-13-14; and for Engineering News-Record, 1913.

REVENUES AND EXPENSES

The fluctuations in gross annual revenue, operating expenses, including taxes, and in net revenues applicable to depreciation, interest, dividends and surplus, expressed in percentage over pre-war conditions, as exemplified by those of the year 1915, are shown in Table 2, and Figure 2, in average amounts and for geographical groups.

It is to be noted that gross revenue, which lagged behind in normal rate of growth from 1915 to and including the year 1919, has grown more rapidly during the years 1920 and 1921.

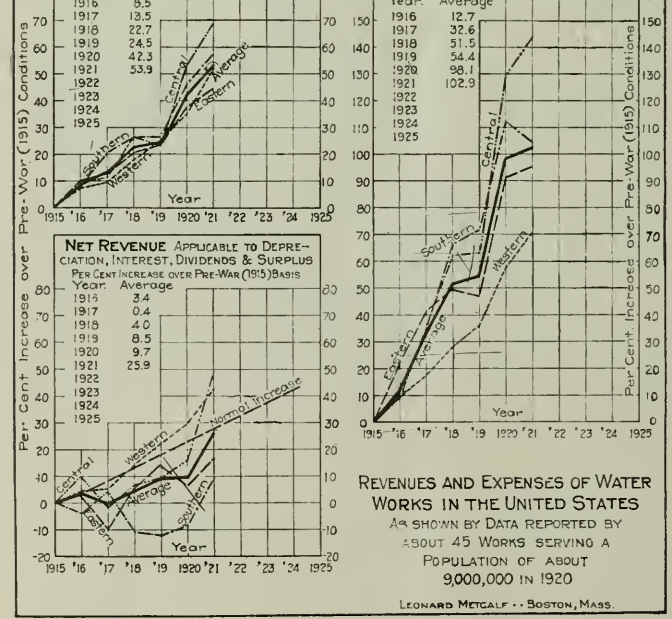
Operating expenses, which continued to increase rapidly up to and through 1920, have increased very much less in 1921. Indeed in the case of the Southern Group there has been an actual decrease in the operating expense of 1920 as compared with 1921, and in many works there has been a decrease in per capita cost of operation.

The net revenue increased at a very slow rate to and including the year 1920. It has improved very materially in the year 1921. The average percentage increase for all groups has recovered to a point but little below the line of increase normal *for pre-war conditions* assumed in 1918 and carried forward as a straight line since that time, though it is far below the plane of present price levels.

In the paper presented in 1919, the statement was made that "the net revenue of water works usually increases at the rate of from 4 to 5% compounded annually." The straight line in Fig. 2, marked "Normal Increase," corresponds to an increase of 3.9% annually without compounding and is, therefore, somewhat below the position which it would have had if the annual increments had been compounded, but the difference is not great and it is interesting to compare the actual conditions developed, with the forecast then made. These differences are shown on the three last lines at the end of Table 2.

Table 2—Increase in Revenues and Expenses of Water Works in the United States Over Those of 1915—In Percentage

	1916	1917	1918	1919	1920	1921
Gross Annual Revenue						
Year						
(a) Eastern Group....	10.1	12.8	20.6	23.3	37.4	44.6
(b) Central Group.....	9.1	11.4	26.4	23.3	53.1	68.9
(c) Southern Group...	7.5	20.3	26.3	26.3	45.9	57.5
(d) Western Group....	7.3	9.5	17.5	25.0	35.6	51.9
Average	8.5	13.5	22.7	24.5	42.3	55.9
Operating Expenses and Taxes						
(a) Eastern Group....	21.9	41.1	49.7	47.1	91.3	95.3
(b) Central Group.....	9.3	37.3	62.3	63.1	129.0	143.9
(c) Southern Group...	9.7	34.6	65.9	71.5	112.8	104.3
(d) Western Group....	9.9	17.4	28.0	36.1	57.7	70.8
Average	12.7	32.6	51.5	54.4	98.1	102.9
Net Operating Revenues Applicable to Depreciation, Interest, Dividends and Surplus						
(a) Eastern Group.....	3.0	—9.6	5.8	14.5	6.3	16.6
(b) Central Group.....	10.0	—1.5	6.5	9.5	16.0	49.3
(c) Southern Group...	—3.7	4.0	—10.9	—12.0	—8.5	9.3
(d) Western Group....	4.3	5.3	14.4	22.1	29.6	42.3
Average (actual).....	3.4%	—0.4%	4.0%	8.5%	9.7%	25.9%
Normal if 4% compounded annually	4.0%	8.2%	12.5%	16.9%	21.7%	26.5%
Normal if 5% compounded annually	5.0%	10.3%	15.8%	21.6%	27.6%	34.0%



A study of Figure 2 and of the last three lines of Table 2, indicate the following comparisons:

Percentage Increases, Over Pre-War Amount (in 1915)) of Net Operating Revenue, Applicable to Depreciation, Interest, Dividends and Surplus, Covering Six-Year Period from 1916 to 1921, Inclusive.

	Total in 6 Years %	Average per Year %
Actual		
Normal	51.1	8.5
Normal compounded annually at 4%.....	89.8	15
Ditto at 5%.....	114.3	19

Expressed in words, this indicates that,—

First, the actual growth in net revenue during the six-year period from 1916 to 1921 inclusive, has been about one-half of that normal for the growth in population and service during this period under *pre-war price and fair return conditions*, despite the effect of such increase in rates as was actually granted in many parts;

Second, the present average net return is slightly below normal *pre-war basis;*

Third, the cumulative losses to the water works of this country, both publicly and privately owned, of this six-year

period (1916-1921) have not been amortized, nor can they be on the present rate basis within a reasonable length of time;

Fourth, while many works have been granted increases in rate which will probably enable them to maintain credit and to make much needed betterments and extensions of plant and service, this is not yet true of the average plants, therefore, many yet remain, the rates of which will have to be still further increased, if desirable standards of service are to be maintained.

Assuming that the "normal increase" line in the net revenue diagram of Figure 2 does represent the increase in net revenue which might normally have been expected under pre-war conditions (though as has been shown, it is really below a normal rate of increase) it is interesting to estimate approximately the extent to which the water works of the country have suffered from the failure to earn the revenue which should normally have accrued to them *under pre-war conditions.* Applying the differences between the assumed normal increase and the actual gain in net revenues for the various districts into which the country has been divided, and making approximate computations, it appears that the works represented by these reports have suffered a loss of upwards of $6,000,000 by the failure to earn the net revenues which might normally have been expected, during the years 1917 to 1921 inclusive. If the same ratio were assumed to hold for the entire country, with some allowance for the small proportion of the population not served by water works, it seems probable that the total loss to the water works of the country has approximated $50,000,000 on *pre-war normal basis.* If proper recognition be given to the higher plane of war and post-war conditions, the amount below a fair return would probably be from four to six times as great, or say roughly, $250,000,000. Or to express the matter in a different way, the water works of this country are on the average back again on the deflated pre-war income basis, though they are still carrying the losses accumulated during the war, whereas the general loss in purchasing power of money or increase in costs would probably justify an average increase in net revenue over pre-war basis of at least 30% and probably as great as 40% or even more in some cases.

These later studies indicate the soundness of the earlier conclusion that the regulatory authorities have found it impossible, under war conditions, at least, to remove the hazard of investment and burden of loss in such enterprises, and that the rate increases granted were not only inadequate but lagged after the adverse conditions by at least eighteen months.

The financial problem involved is not yet solved. It is a difficult thing, practically, to increase rates now, where no increase or inadequate increase was granted during the war period,—in the face of lower and yet declining prices. But such increase is essential in many if not most cases, if desirable standards of service are to be maintained. The public wants, is entitled to have, and is ready to pay for, a really high standard of service. The difference in cost to the family, between the good and the mediocre or inadequate service, is probably considerably less than is spent by many a family in chewing gum. Water service is by far the cheapest of all public services and easily within the resources of the public.

The public and the individual has a right to demand that the water service shall be good in every respect and that fair margins of safety shall be maintained.

The administrators and regulators of water works have no right to carry the hazards and take the chances incident to a water supply which is inadequate, either in quality, in quantity, or in pressure.

The war is past and sound economic doctrine demands that the water works should be rehabilitated first of all, as they are the utilities most important to the public health and they involve the least cost to the public.

It is encouraging to note that, despite the difficulties involved, some of the Utilities Commissions are coming to sense the inherent dangers of the situation and the desirability of somewhat more liberal standards than those of the past. Already several have considered means of amortizing losses of the war period, recognizing that failure to do so must have the inevitable effect of retarding recovery.

It is with the water works as with the individual. To deny good food and living conditions and normal hope of recovery to the patient recuperating from a long and serious illness, is but to court death or further continued burden of expenses; whereas a friendly attitude and atmosphere of encouragement, with occasional assistance from a competent doctor, on the other hand, hastens recovery and lightens the burden of all.

Burning Liquid Fuel

Burning Liquid Fuel, revised edition, by the late William Newton Best, is a book of 6x9 inches, 341 pages, 316 illustrations, published by U. P. C. Book Co. This book is a practical treatise on the perfect combustion of oils and tars viewed from a scientific, chemical and mechanical and industrial standpoint, giving analyses and calorific values of various oils with information on the design and proper installation of equipment for all classes and sizes.

The author was an inventor holding 44 patents in the oil burning industry, was president and consulting engineer of the W. N. Best Furnace Burner Corporation and a member of many technical and scientific organizations. Most of his life was devoted to perfecting oil burners for practical and economic service and his opinions on such subjects were authoritative.

Of the 28 chapters into which the book is divided, those of special interest are on atomization, low pressure boilers, commercial gas industry equipment, cement industry equipment, oil and tar equipment, incinerator equipment, and oil systems. The author discusses the method whereby liquid fuel is supplied to the burners, shows many general plans and arrangements, details of important features and points out the items of proper and of improper oil systems. Valuable stationary boiler data are given and there are numerous diagrams and plans besides half-tones and detail engravings, many of them referring to burners, furnaces and installations that were invented by the author.

Calyx Drill Pavement Tests

The North Carolina State Highway Commission removes specimens from hard-surface roads with a mobile core drill outfit, and sends them to the State Laboratory at Raleigh for size, strength and analysis tests to determine if they fully meet specifications.

The equipment that they use is installed on a three-ton Kelly Springfield truck which, in addition to the drill proper, also carries molds for making concrete repair plugs; bins for sand, stone, and cement for repair plugs; a 130-gallon water tank and hand force pump so that the tank can be refilled from rivers or creeks; accessories for the work and for repairs. The drill is mounted flush with the rear end of the truck body and is driven by a belt from an 8 h. p., two-cylinder, four-cycle gasoline engine mounted just to the rear of it, and having its own gasoline tank and radiator, being thus independent of the truck for power.

The patented type drill head, designed for road testing service, is capable of drilling from any hard-surfaced road a core 6¼ inches in diameter. The cylindrical drill bit is of soft steel, and has a slightly rounded face. It is rotated at approximately 200 revolutions per minute on a thin layer of steel shot which are fed through the bit and which lie between the face of the drill and the material to be drilled. They are broken into sharp pieces which partially imbed themselves in the drill bit, thus forming an abrasive surface which rapidly wears through the material on which it is placed.

Water is fed to the cutting face of the drill and serves the double purpose of cooling the bit and of washing the pulverized material from the hole. Under average conditions about three gallons of water are used in drilling a core from an 8-inch pavement. After the hole has been drilled through the pavement the bit is raised, the core lifted from the hole and marked for identification when shipped to the laboratory.

A guide board is used for centering and holding the bit in place when starting a new hole. After penetrating half an inch the bit follows the groove which it has cut. The 7½-inch bit, which is the size used by the Commission, will drill through an 8-inch pavement in about 20 or 30 minutes, using approximately three pounds of shot.

The holes which are left in the pavement when the core is removed are filled with a concrete plug previously cast, the diameter of which is slightly less than that of the drilled hole. These plugs are dropped into place and grouted with quick setting cement so that the road is left in good condition.

The same type of machine is used by the Indiana Highway Commission, and recently the Commission refused to pay for 1,128 feet of concrete pavement, part of a contract of about eleven miles, because of the discovery by this machine of skimping of thickness. This discovery resulted in the dismissal of five inspectors and engineers, and in giving the contractor the alternative of taking up and relaying these sections or of giving it to the state, the latter of which alternatives was chosen by him.

An unusual accident recent occurred at the Wanaqua Dam, N. J., when a concrete form six feet high burst, due to defective rods, and killed two men.

Table 2—Cost of Sand, Gravel and Crushed Stone

Compiled from Data Furnished by City Engineers. Supplementing Table in the February 18 Issue.

Name of City	Cost, Delivered on the Street of			
	Sand Per cu. yd.	Gravel Per	Crushed Stone Per ton	
Alabama				
Fairfield	3.25	....	2.30	
Arizona				
Bisbee	2.50	yd.	2.50	yd.
Clifton	1.25	cu. yd.	....	....
Florence	1.00	yd.	2.50	yd.
Yuma	1.25	sq. yd.	2.50	sq. yd.
Arkansas				
Texarkana	2.00	yd.	2.75-3.50	ton
California				
Alhambra	.75	yd.	1.00	ton
Bakersfield	.80	ton	2.50	ton
Chico	3.25	yd.	2.75	ton
	2.25	ton	4.10	cu. yd.
	2.25	cu. yd.	2.50	ton
Modesto	2.25	cu. yd.	2.25	cu. yd.
Monrovia	1.00	yd.	2.40	....
Richmond	2.25	yd.	2.40	cu. yd.
Santa Monica	2.25	cu. yd.	2.50	cu. yd.
Colorado				
Colorado Springs	1.10	cu. yd.	....	....
Leadville	3.50	ton	1.75	ton
Montrose	2.50	yd.	....	....
Connecticut				
Ansonia	2.25	cu. yd.	2.50	ton
Bridgeport	2.00-2.50	cu. yd.	3.00	ton
Danbury	2.25	cu. yd.	2.50	ton
Stamford	2.50	cu. yd.	3.25	cu. yd.

Table 2—Cost of Sand, Gravel and Crushed Stone—(Cont.)

Name of City	Cost, Delivered on the Street of			
	Sand Per cu. yd.	Gravel Per	Crushed Stone Per ton	
Mississippi				
Jackson	2.00	cu. yd.	2.00	cu. yd.
Vicksburg	2.25	cu. yd.	2.75	cu. yd.
Missouri				
Cape Girardeau	2.00	cu. yd.	....	....
Morett	2.00	cu. yd.	1.25	cu. yd.
Montana				
Billings	2.50	cu. yd.	2.25	cu. yd.
New Jersey				
Camden	1.00-2.00	cu. yd.	1.90	cu. yd.
Roselle Park	2.50	ton	3.50	ton
Rutherford	1.50	cu. yd.	....	....
South Orange	2.50	ton	2.50	ton
Westfield	1.75	cu. yd.	1.75	cu. yd.
West New York	3.00	yd.	3.50	yd.
New Mexico				
Clovis	3.00	cu. yd.	3.00	cu. yd.
Santa Fe	1.00	cu. yd.	1.50	cu. yd.
New York				
Amsterdam	2.70	yd.	....	....
Auburn	1.50	ton	....	....
Carthage	2.00	yd.	2.25	yd.
Endicott	2.50	cu. yd.	1.90	cu. yd.
Jamestown	1.85	cu. yd.	1.50	cu. yd.
Malone	1.33	cu. yd.	1.33	cu. yd.
New York City:				
Manhattan	1.85	....	2.70	....
Brooklyn	1.29	cu. yd.	2.61	cu. yd.
Queens	1.57	cu. yd.	....	....
Richmond	2.75	cu. yd.	....	....
Saranac Lake	2.75	(load 2 yds.)	3.00	load
Troy	1.25	cu. yd.	2.25	cu. yd.
Waverly	2.00	yd.	2.00	yd.

District of Columbia						
Washington	.80	cu. yd.	1.20	cu. yd.	2.47	ton
Florida						
Jacksonville	2.50	cu. yd.	....	....	4.50	cu. yd.
Georgia						
Albany	....	....	3.00	ton	....	....
Brunswick	1.00	cu. yd.	1.00	cu. yd.	3.00	ton
Idaho						
Idaho Falls	3.00	cu. yd.	.85-1.00	cu. yd.	1.00	cu. yd.
Pocatello	1.50	cu. yd.	1.25	cu. yd.	3.00	cu. yd.
Illinois						
Chicago	2.97	cu. yd.	2.97	cu. yd.	2.35	cu. yd.
Freeport	2.50	cu. yd.	2.50	cu. yd.	3.00	cu. yd.
Oak Park	3.00	cu. yd.	3.00	cu. yd.	3.00	cu. yd.
Indiana						
Bicknell	2.50	cu. yd.	2.50	cu. yd.	3.50	cu. yd.
Logansport	2.00	yd.	2.00	yd.	2.25	yd.
Newcastle	2.60	cu. yd.	2.70	cu. yd.	....	....
Wabash	1.50	cu. yd.	1.50	cu. yd.	1.80	ton
Iowa						
Waverly	1.00	yd.	1.50	yd.	1.20	ton
Kansas						
Independence	3.25	cu. yd.	....	....	2.00	cu. yd.
Manhattan	2.10	cu. yd.	3.00	cu. yd.	2.75	cu. yd.
Kentucky						
Frankfort	2.00	cu. yd.	2.00	cu. yd.	2.00	cu. yd.
Madisonville	2.30	cu. yd.	2.30	cu. yd.	2.10	ton
Paducah	1.50	cu. yd.	1.50	yd.	2.15	ton
Shepherdsville	....	....	....	....	2.00	ton
Louisiana						
South Highlands	1.50	yd.	5.25	yd.	6.50	yd.
Maine						
Lewiston	....	....	1.15	....	1.70	ton
Rockland	2.25	ton	2.25	cu. yd.	1.20	ton
Maryland						
Baltimore	2.00	ton	1.40	cu. yd.	1.75	ton
Easton	2.50	cu. yd.	2.50	cu. yd.	3.50	ton
Hagerstown	2.10	ton	....	....	1.70	ton
Massachusetts						
Boston	2.00	yd.	2.00	yd.	2.50	ton
Brookline	1.80	ton	1.60	ton	2.50	ton
Danvers	.50	yd.	.50	yd.	2.00	ton
	at pit		at pit			
Gardner	1.00	cu. yd.	1.00	cu. yd.	2.80	cu. yd.
Greenfield	1.25	cu. yd.	2.00	cu. yd.	2.70	ton
Lee	2.50	cu. yd.	2.25	cu. yd.	2.50	cu. yd.
Lowell	.95	cu. yd.	....	....	2.48	ton
Malden	2.75	yd.	2.75	yd.	2.25	ton
Milton	2.00	cu. yd.	2.00	cu. yd.	2.00	ton
Newton	1.00	ton	1.00	ton	2.50	ton
Peabody	2.50	yd.	2.50	yd.	1.55	ton
Reading	.40	cu. yd.	.65	sq. yd.	1.50	sq. yd.
Revere	2.00	cu. yd.	2.00	cu. yd.	3.10	ton
Taunton	1.25	cu. yd.	2.50	cu. yd.	2.50	ton
Waltham	2.50	cu. yd.	1.00	cu. yd.	2.50	ton
Worcester	1.50	yd.	1.50	yd.	2.00	ton
Michigan						
Flint	3.30	cu. yd.	3.00	cu. yd.	....	....
Kalamazoo	1.20	cu. yd.	1.40	cu. yd.	....	....
Menominee	2.50	ton	2.75	ton	2.50	ton
Munising	....	....	2.72	ton	3.02-4.50	ton
Muskegon	2.25	cu. yd.	3.60	cu. yd.	2.90	ton
Port Huron	2.00	cu. yd.	3.75	cu. yd.	....	....
Saginaw	1.60	ton	1.60	ton	2.19	ton
Minnesota:						
Duluth	1.50	yd.	1.30	ton	1.30	ton
Fairmont	1.80	ton	3.60	ton	3.70	ton
Luverne	1.10	ton	....	....	2.85	ton
Minneapolis	1.75	cu. yd.	2.75	cu. yd.	2.75	cu. yd.
Virginia	2.75	cu. yd.	3.00	cu. yd.	3.35	cu. yd.
North Carolina						
Durham	1.50	cu. yd.	....	....	3.50	ton
Washington	1.25	cu. yd.	3.75	cu. yd.	....	....
Ohio						
Barberton	1.50	cu. yd.	1.50	cu. yd.	....	....
Bellefontaine	2.50	cu. yd.	1.25	cu. yd.	1.25	ton
Canton	2.00	cu. yd.	2.00	cu. yd.	....	....
Chillicothe	1.25	cu. yd.	1.25	cu. yd.	....	....
Circleville	.70	sq. yd.	.80	sq. yd.	1.90	sq. yd.
Dayton	1.50	cu. yd.	1.50	cu. yd.	....	....
Newark	1.00	sq. yd.	1.00	sq. yd.	....	....
Painesville	2.00	cu. yd.	2.00	cu. yd.	2.20	ton
South Point	3.00	cu. yd.	3.00	cu. yd.	3.00	cu. yd.
Washington C. H.	1.75	cu. yd.	1.75	cu. yd.	2.00	cu. yd.
Wilmington	1.75	yd.	1.75	yd.	1.75	yd.
Oklahoma						
Altus	2.00	cu. yd.	2.00	cu. yd.	2.95	cu. yd.
Blackwell	1.25	yd.	4.25	yd.	4.00	yd.
Wagoner	2.50	cu. yd.	2.50	cu. yd.	3.25	cu. yd.
Oregon						
Ashland	2.00	cu. yd.	2.00	cu. yd.	....	....
Bend	1.50	yd.	1.50	yd.	....	....
Dallas	2.50	cu. yd.	2.00	cu. yd.	3.25	cu. yd.
Pennsylvania						
Altoona	3.00	ton	....	....	2.50	ton
Athens	2.00	yd.	2.00	ton	3.75	yd.
Bangor	2.00	ton	2.00	yd.	2.50	ton
Bellefonte	2.25	ton	....	....	1.10	ton
Erie	1.50	yd.	2.00	yd.	3.04	ton
Jersey Shore	2.00	cu. yd.	1.50	cu. yd.	1.50	cu. yd.
Meadville	1.95	ton	1.75	ton	....	....
Midland	1.86	ton	1.70	ton	....	....
Northampton	1.65	ton	....	....	1.40	ton
Philadelphia	2.05	cu. yd.	2.00	ton	2.40	ton
Sayre	2.00	yd.	2.00	yd.	3.75	yd.
Sharon	2.25	ton	2.25	ton	....	....
Woodlawn	2.60	ton	2.40	ton	....	....
Rhode Island						
Bristol	3.00	ton	4.00	yd.	4.00	ton
Cranston	1.60	cu. yd.	1.60	cu. yd.	2.40	ton
South Dakota						
Rapid City	1.20	ton	....	....	2.95	ton
Tennessee						
Greeneville	3.00	cu. yd.	....	....	3.00	cu. yd.
Harriman	2.00	cu. yd.	....	....	4.00	cu. yd.
Texas						
Brownwood	2.50	yd.	2.50	yd.	....	....
Childress	2.50	cu. yd.	2.50	cu. yd.	3.50	cu. yd.
Cleburne	2.40	cu. yd.	3.00	cu. yd.	3.90	cu. yd.
Greenville	3.25	cu. yd.	3.10	cu. yd.	2.75	ton
Houston	1.20-1.60	cu. yd.	3.45-4.15	cu. yd.	3.45-4.15	cu. yd.
Navasota	1.50	cu. yd.	....	....	....	....
Port Arthur	2.65	cu. yd.	4.12	cu. yd.	....	....
San Angelo	1.50	yd.	.65	yd.	1.25	yd.
Utah						
Ogden	1.75	cu. yd.	1.75	cu. yd.	....	....
Washington						
Olympia	2.00	cu. yd.	2.00	cu. yd.	....	....
Port Angeles	2.15	cu. yd.	2.15	cu. yd.	....	....
Walla Walla	3.25	cu. yd.	3.00	cu. yd.	....	....
Wisconsin						
Augusta	1.75	cu. yd.	2.00	cu. yd.	....	....
Eau Claire	1.25	cu. yd.	....	....	3.00	ton
Janesville	1.20	ton	1.50	ton	....	....
Marinette	2.50	ton	2.75	ton	2.50	ton
South Milwaukee	1.75	yd.	2.00	yd.	2.25	yd.
Wyoming						
Laramie	1.00	cu. yd.	.90	cu. yd.	2.50	cu. yd.

NEWS OF THE SOCIETIES

CALENDAR

June 1—MOHAWK VALLEY ENGINEERS' CLUB. Trout Brook Inn, Utica. Secretary—Walter F. Hudson, 222 Genessee street, Utica, N. Y.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff, 60 State St., Boston, Mass.

June 6-8—CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Idaho.

June 12—AMERICAN FEDERATION OF LABOR. Cincinnati, Ohio.

June 12-15—CANADIAN GOOD ROADS ASSOCIATION. Ninth annual meeting. Empress Hotel, Victoria, B. C. (Change of date.)

June 13—ENGINEERING SOCIETY OF AKRON. Akron, Ohio.

June 16-17—ENGINEERING INSTITUTE OF CANADA, Provincial meeting. Vancouver Hotel, Vancouver, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention. Crookston, Minn.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 15-18—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

The annual meeting was held May 17 at the Engineering Societies Building, New York City. The subject: "Need of Regional Planning for the New York District," was introduced by Charles D. Norton, chairman of the Committee on Plan of New York and Its Environs, who said the foundation would finance the preliminary work and that the limit of the district included in the plan extended from Montauk Point to Bridgeport, Conn.; to West Point, N. Y.; to Princeton, N. J., and thence to the Atlantic Ocean.

Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, described the present plan of New York and how it came about; H. M. Lewis, of the staff of the Committee on Plan of New York and its Environs, outlined some of the work which has been done preliminary to the development of a regional plan; Jay Downer, engineer and secretary of the Bronx Parkway Commission, spoke of the opportunities for regional planning in Westchester and Putnam counties; Morris R. Sherrerd, consulting engineer, Newark, N. J., discussed the possibilities of regional planning in Northern New Jersey; and Bertram H. Saunders, chairman of the City Plan Commission, of Paterson, N. J., explained the original plan for that city made by Major L'Enfant, and the plan being worked out by the commission.

J. V. Davies was elected president; F. C. Noble, vice president; C. W. Leavitt, vice president; H. M. Lewis, secretary; C. R. Hulsart, treasurer, and W. G. Grove and W. C. Briggs, directors.

A sub-section group conference was held to discuss the subject: "How Much Detail Should be Included in Specifications?" A resolution on laws to fix responsibility of engineers will be discussed. James H. Edwards, assistant chief engineer, American Bridge Company, presided and introduced the subject.

ENGINEERS' SOCIETY OF MILWAUKEE

A meeting of the Engineers' Society of Milwaukee, held under the auspices of the Milwaukee section of the American Society of Mechanical Engineers, was held at the Milwaukee Athletic Club, May 17. The feature of this meeting was an illustrated address on "Variable Speed Hydraulic Transmission of Power," by Walter Ferris, vice president of the Oil Gear Co. and consulting engineer of the Bucyrus Co., Milwaukee.

BOSTON SOCIETY OF CIVIL ENGINEERS

The subject of the May 17 meeting of the Boston Society of Civil Engineers was "City Planning." Planning projects in nearby municipalities were discussed by several members of the society and addresses were delivered as follows: "City Planning," by George H. Nye, city engineer of New Bedford; "City Planning for Boston," by Miss Elizabeth M. Merlihy, secretary of the Boston City Planning Board; and an illustrated talk on "City Planning Developments in Newton, Fall River, Bridgeport and Certain Towns in the Metropolitan District," by Arthur A. Shurtleff, town planner.

ROCHESTER ENGINEERING SOCIETY

A joint meeting of the Rochester Engineering Society, with the Rochester Section of the American Society of Mechanical Engineers, was held in Rochester on May 19, with President Rush Rhees, of the University of Rochester, presiding. Dexter S. Kimball, president of the American Society of Mechanical Engineers and dean of Sibley College, Cornell University, was the speaker of the meeting. Laboratories and equipment of the department of engineering were inspected.

FLORIDA ENGINEERING SOCIETY

The annual meeting will be held at the Casino Burgoyne, Daytona, Fla., May 15th and 16th. The Florida Association of Architects will be in session at the same time and place. The State Board of Engineering Examiners will hold a regular meeting at Daytona, May 15th and 16th.

In addition to the regular reports of officers and committees, the program will include the following papers or addresses:

"Waves and the Engineer" (presidential address)—C. S. Hammatt, President Florida Engineering Society.

"Florida Highways"—C. A. Browne, Chief Engineer, Orange County Road Department.

"Foundations"—C. J. A. Dittmar. Consulting Engineer.

"Activities of the American Engineers in France"—A. F. Harley, Civil Engineer.

"Drainage in Florida"—George B. Hills, member of George B. Hills Company.

"Foundations"—Ben Johnson, dredging contractor.

"The Phosphate Industry in Florida"—H. D. Mendenhall, consulting engineer.

"Report on Reciprocal Registration"—C. S. Hammatt, President of the National Council of State Boards of Engineering Examiners.

There will be motor trips and a clam bake or fish fry on the beach.

PERSONALS

McDonald, N. G., town engineer of Oshawa, Ont., has resigned.

Colin, Thomas, superintendent of the water department at Caledonia, N. Y., has resigned to engage in business for himself.

Albert, H. L., of Green Bay, Wis., has been appointed city engineer of Seymour, Wis.

Helland, H. R. F., has been made assistant sanitary engineer of the state board of health of Texas.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

PAYNE DEAN'S EMERGENCY SHUT-OFF TRUCK

AEROIL BURNER COMPANY'S KEROSENE TORCH USED IN REPAIRING ASPHALT PAVEMENT

EMERGENCY VALVE SHUT-OFF TRUCK

The Dean Emergency "Shut-off Truck," manufactured by Payne Dean, Limited, consists of a 1922 model Reo Speed Wagon chassis fitted with improved Dean valve operating takeoff. This is a special transmission permanently attached to the chassis, arranged to carry square valve operating keys of different lengths. All three forward and reverse speeds are available for operating.

On each valve in the zone of operation is attached a Dean Position Indicator, which indicates the exact number of turns the valve is open. This indicator is applied to the valve without any alterations whatever, and takes the place of the valve nut. The operating end has a standard 2-inch nut to suit both truck and hand wrenches.

On the dash in front of the driver is the automatic cut-off indicator having an illuminated dial and adjustable numbers. The numbers on this dial are set to correspond with the numbers on the dial of the valve position indicator, after which the clutch is let in through, say, the second speed of the car. The valve completely closes, and the engine automatically stops. It is impossible to jam the valve, and for further protection the cut-off may be set to stop a few turns from full closed position.

The automatic cut-off operates also when opening the valve. By the aid of special universal joints, the vertical key shaft may be as much as 10 inches off center. An adjustable shear coupling in an accessible position is provided for protecting the valve stem.

A special low head centrifugal pump is provided under the rear of the body, driven by the transmission and provided with clutching and de-clutching device.

AEROIL KEROSENE TORCH

The Aeroil double or single kerosene torch outfit manufactured by the Aeroil Burner Co., Inc., is made with ten or fifteen gallon steel pressure tank with cups, gates and fittings and holds one or two torches with 2½x18-inch or 3½x28-inch flames and for steet repair work can be equipped with special brackets on which to rest the torch on the pavement so that the flame shall cover the largest possible area and eliminate the necessity of a man to hold the torch.

It can be used for rough handling, is absolutely safe and fool-proof, and provides a strong, reliable blue flame. With it the time required for cutting asphalt pavement can be reduced 50 to 75 per cent. by heating the asphalt surface before using the cutting axe. After removing the old asphalt the torch is again used to dry out the opening and heat the surface so that the bituminous patch secures perfect adhesion. This enables the repair work to be done both in wet weather and in winter.

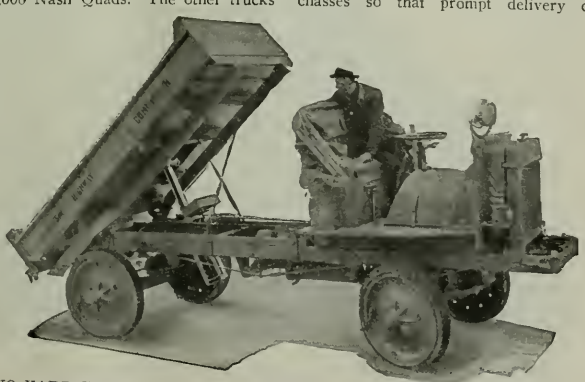
DUMPING EQUIPMENT FOR WAR DEPT. TRUCKS

There is a large and constantly increasing number of State and County Highway Departments that are installing Heil Dumping Equipment on the trucks allotted them by the Federal Government. Some states have more than 200 of these units in operation.

There have recently been allotted more than 500 Class B Liberty Trucks and during the past two or three years 3,000 or 4,000 Nash Quads. The other trucks which have been furnished are: 3-ton Packard, 2 and 5-ton Pierce Arrow, 3-ton Heavy Aviation, 3-ton Riker, 3-ton F. W. D., in varying quantities.

Heil dumping units have been designed to meet the exact requirements of the County and State Highway Commissions. They are designed to fit the particular chasses on which they are mounted and to give 100 per cent. service on those trucks.

The Heil Company carries a stock of bodies and hoists for these particular chasses so that prompt delivery can



TWO-YARD HEIL BODY AND HOIST ON NASH QUAD ARMY TRUCK.

easily be made to counties or townships requiring equipment.

This type of body is square cornered and straight sided, with the front end crowned, and is best adapted for road work because it permits cement block, lumber, tile, etc., to be piled in close to the bottom edges which would not be possible if these were rounded.

All Heil bodies are tapered 3 inches wider at the rear than at the front so that the load will free itself when elevated. Tail gates for the bodies are hinged at the top and bottom. When opened at the bottom they are used for dumping gravel, sand and the like. When opened from the top and folded down they extend the platforms so that long materials such as pipes, beams and the like can be handled very readily.

The operating device used is known as the Heil's 100 per cent Manual Control. A patented gooseneck hook is extended through the rear body brace, reaches out and draws the gate tightly to the body. A handle at the front of the body operates an eccentric device which goes over center when closed, locking the tail gate shut.

The Hydro Hoist for dumping these bodies is the simplest type hydraulic hoist on the market. It is mounted under the body, thus allowing the body to utilize all of the loading space back of the cab. On these War Department trucks this permits the use of a much lower sided body than could be obtained with a hoist mounted back of the cab.

The lifting power of the hoist is practically unlimited. Moreover, it can dump a load with one rear wheel much lower than the other. The hoist pistons are attached directly to the body sub-frame so that the body cannot tip over backward. A gear pump located in the front of the hoist forces oil from the upper part of the cylinder to the lower part of the cylinder and raises the body. All high pressure piping, rollers, cables, sheaves and the like have been eliminated. The load rests on a cushion of oil, having an average bearing surface of 53 square inches. The Heil Hydro Hoist gives dependable service. All parts are standardized and interchangeable.

ROAD REPAIR EQUIPMENT COMPANY'S PORTABLE MACHINE WITH HEATING TANK

ROAD REPAIR IMPROVED HEATER

A new heater for asphalt binder and other similar materials has just been put on the market by the Road Repair Equipment Co., after developing the design by careful tests and verifications by six months of successful practical service.

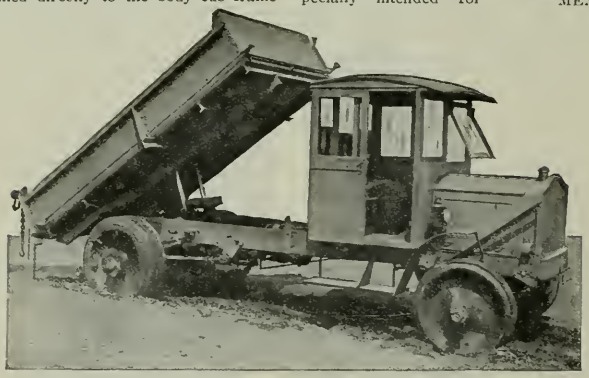
This heater is especially intended for repair work and to facilitate the application of small quantities of road material at points distant from central mixing asphalt plant where it would otherwise be difficult and expensive to mix, heat and apply a small amount of material that in this case can be done by a single man with convenient portable equipment that can be readily delivered at any point. It is sufficient to repair in one operation a place requiring three cubic yards of material.

The machine is similar to an ordinary steel wheelbarrow except that the body is built special and contains a secondary large body or tray with a predetermined space allowed between the tray and the special body. In this space there is installed a gasoline burner producing a hot flame that spreads over the bottom of the tray and provides a uniform heat throughout its area. The burner is supplied with fuel and from a cylindrical tank mounted on the wheelbarrow handles adjacent to the end of the body and supplied with a hand force pump to secure a proper admixture of air with gasoline.

The operator can control the flow of gasoline to the burner so as to secure any required intensity of heat by means of a needle valve that instantly regulates it and promotes the saving of gasoline.

DUMPING BINDER FROM ROAD REPAIRS, EQUIPMENT COMPANY'S PORTABLE MACHINE

With this appliance, supplies of stone and bituminous material may be placed at convenient intervals along the road and the patrolman, inspector or workman starting in the morning, loads the heater and upon reaching the first hole, lights the gasoline torch, heats and mixes the material to the proper temperature and consistency, pours it into the hole, levels and tamps it, completing a patch under favorable circumstances in less than five minutes and continues to the next one, and is thus able to work with rapidity, efficiency and convenience. As the heating is always uniform the patching may be done in extremely cold weather and is maintained immediately whenever a portion of the road starts to break or disentegrate, keeping it in good conditions and saving expensive repairs.



HEIL HOIST AND BODY ON PACKARD 3-TON ARMY TRUCK, MODEL 55C

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 June 3, 1922 No. 22

Pine Hill Dam

Main Section, Spillway, Bridge and Walls contain 55,000 yards of concrete. Foundations 62 feet deep built in 10 sections with iron stop plates in construction joints. Water cushion formed by weir. Part of main dam built in narrow long sections temporarily serving as cofferdams. Bypass eliminated. Foundations 62 feet deep grouted 30 feet deeper. Crushed stone used for sand.

The Pine Hill Dam, about 1,000 feet long and 113 feet in extreme height above the bottom of the lowest foundation, is now in an advanced state of construction and has been built by day forces of the city of Worcester, Mass.

It has cost to the present time about $800,000, while nearly $1,500,000 has been expended on the entire project connected therewith.

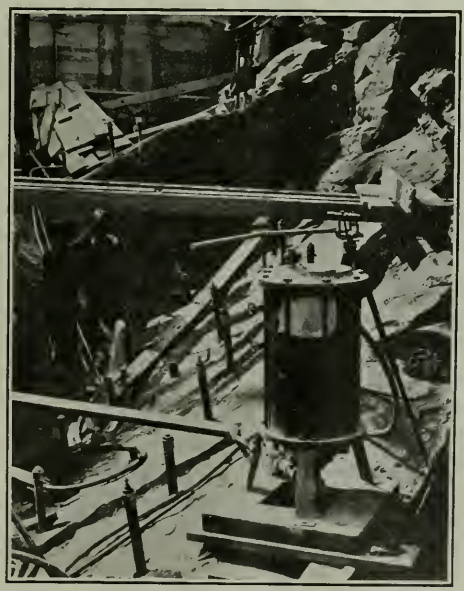
It will impound 2,997,000,000 gallons of water in the Pine Hill reservoir constructed on Asnebumskit brook in the towns of Holden, Paxton and Rutland and is located some ten miles from the city.

The 6.90 square miles of area draining into it was originally a part of the watershed of the Nashua river, feeding into the great Wachusett reservoir of the Metropolitan Water Works, but provision for the taking of this area by the city of Worcester was made by the State Legislature in the act creating the Metropolitan Water Board in 1895.

MAIN SECTION AND SPILLWAY

The dam has a central portion of cyclopean concrete masonry with expansion joints about every 40 feet and is 373 feet long, 80 feet wide in the deepest sections and 17½ feet on top. At each end of this main structure is a buttress from which a concrete core wall continues into the hill on either end. These concrete core walls are reinforced by earth embankments with a total width of 25 feet on top and with slopes of 2 to 1.

The up-stream face of the main section is perpendicular, while the down-stream face is on a vertical curve and slope running from the 17½ feet width on top to the width of 80 feet in the maximum section. An 83-foot spillway is provided in the central portion of the dam at an elevation of 10 feet below its top, and across this is a three-arch reinforced concrete bridge.



GROUTING FOUNDATION HOLES 30 FEET DEEP UNDER DOUBLE MAXIMUM HYDROSTATIC PRESSURE

As the water passes over this spillway it is guided down the face of the dam by walls on either side which lead it into a semi-circular pool having a massive concrete floor and reinforced concrete baffle blocks to break up the velocity of the water as it falls into the 7-foot cushion of water, retained by a weir wall.

CONSTRUCTION JOINTS

The foundation for the concrete portion of the dam in the bed of the valley was carried down to solid rock at a maximum depth of 62 feet below the surface, and this portion of the dam was built in 10 sections

separated by transverse vertical joints providing construction expansion joints. In the spillway fourteen vertical bonding grooves 12 inches wide and 2½ inches deep were provided.

In addition there is a set of vertical longitudinal 12 x ½-inch ingot iron stop plates imbedded 6 inches in one section of the dam and projecting 6 inches into the adjacent section and reaching full height from top to bottom of dam, 5½ feet from the vertical or up-stream face.

About nine feet down stream from this stop plate, in the same transverse vertical plane, there is a full depth 6 x 12-inch drainage well communicating with a horizontal 4 x 6-foot inspection gallery that runs from end to end of the concrete dam at about the same grade and elevation as the original surface of the ground.

The supply from the reservoir is carried through the dam in a 30-inch cast-iron pipe built into the concrete 60 feet below the crest of the spillway. This pipe enters the bottom of the supply well, which is provided with inlet gates at three levels in the up-stream face of the dam. The lower end of the pipe is controlled by a gate installed in a gate house at the ground level just below the toe of the dam.

The dam and its appurtenances are to contain about 55,000 cubic yards of 1:2½:5 concrete and 67,000 cubic yards of earth embankment. It will also require the excavation of 40,000 cubic yards of earth and 11,000 cubic yards of rock; as well as the quarrying of some 75,000 cubic yards of stone from the quarry located nearby.

The site selected for the dam's location presented somewhat difficult conditions. The southerly end was located on a foundation of irregular rock formation which was practically entirely exposed, without any covering of earth. Starting at the foot of this hill, however, and crossing the valley in a northerly direction the strata of rock fell away so rapidly that there was a depth of nearly 62 feet of earth covering the ledge at the northerly buttress, just beyond which point the concrete section was narrowed to a core wall. This wall was continued into the hill, being well bedded in heavy clay hard pan.

EXCAVATION

The rock excavation on the southerly hill had a maximum depth of 45 feet owing to its seamy structure. This depth of excavation ran southerly to a depth of 12 feet and northerly to a depth of 5 feet. These various depths of soft rock were removed by drilling, barring and wedging before reaching a solid foundation. This excavated material was disposed of by guyed derricks to trains on the narrow-gauge railroad, to be taken to the crusher, saved for riprap or disposed of as waste, just as the nature of the material seemed to warrant.

GROUTING

While the rock excavation was thus carried down to what appeared to be a solid foundation, yet the ledge was treated for seams and fissures to a depth of from 25 to 30 feet below the bottom of this excavation.

Three lines of 2-inch holes, averaging about 6 feet apart, were drilled to these depths running the entire length of the main dam and into the southerly hill.

They were parallel to and ranged from 1 to 12 feet from the up-stream face of the dam. These were grouted under a pressure equal to twice that of the water when the reservoir is filled. It is believed that the seams were thus thoroughly sealed and all danger of serious upward pressure on the foundation was eliminated by the use of about 350 barrels of cement required for the grout.

The first excavation made for the dam was to provide an earthern channel to care for the stream at the toe of the northerly hill. With this in operation the foundation for the southerly end of the dam was made and the structure raised to the elevation of the old stream.

CONCRETE FORMS COFFERDAM

Temporary concrete wing walls were then built to connect with the part of the dam finished, and with these as coffer dams the water was turned across the partly completed section.

This effective method saved the building of any flume, and made a channel absolutely water tight so far as any leakage was concerned. This has made the care of the water a simple one during construction and thus little pumping has been required except to care for the surface water.

This section which has been left low during construction can be raised and completed when desired, the 30-inch pipe being sufficient to care for the stream during the dry season.

As the excavation was carried northerly across the valley it was made first in open cuts, with slopes, to a depth of about 20 feet into the earth, beyond which, however, sheeting was used. Parallel trenches each 16 feet wide with 2-inch sheeting were opened up, one on the upper and the other on the toe sides of the dam and were carried down to bed rock. When this excavation was completed and in readiness, concrete was filled in, which then acted as retaining walls to permit the removal of the section left between them.

These walls were immediately raised to a sufficient height so that by the use of guyed derricks it was possible to deposit this earthern core back of them as a part of the embankment.

CONCRETING AND PLANT

The bottom of the rock excavation was left very jagged and irregular, affording a splendid bond with the ledge, and the concrete was laid in subdivisions to break joints so far as possible except where the expansion joints were designed.

The concrete was mixed in plants established at each end of the dam and was delivered to the work by ⅝-yard buckets handled by a trolley hoist on a cableway installed approximately on the center line of the top of the dam. It was also delivered by derricks and placed by either or both as was most convenient.

The plums for the cyclopean concrete were delivered on the service tracks and were placed by three derricks seated on the dam and shifted from time to time as the concreting advanced.

The cyclopean concrete contained about 20 per cent of large stone up to one yard in volume and was placed at a maximum rate of 2,000 yards per month.

CONSTRUCTION OF LOWER PART OF FIRST THREE SECTIONS OF DAM WITH EXPANSION JOINTS BETWEEN THEM

The average force employed was about 215 men and the wages paid in 1921 varied from $4.00 per 8-hour day for common labor to $7.00 for skilled men. The work has been done entirely without the use of teams.

The principal items of plant and equipment included one Lidgerwood cableway, one 10½D Acme stone crusher, four 8-ton locomotives, four hoisting engines, two concrete mixers, one Telsmith intercone mill, two air compressors, two locomotive type boilers for operating stone crusher and cableway, and five derricks.

SAND AND CEMENT

The crushing plant was designed in three units, made necessary by the fact that all sand used in the concrete has been made from stone, due to an absence of sand in this vicinity. The result has been accomplished by crushing and then running the required per cent of broken stone through a Cages Telsmith intercone mill and sand rolls until a product has been obtained superior to standard sand.

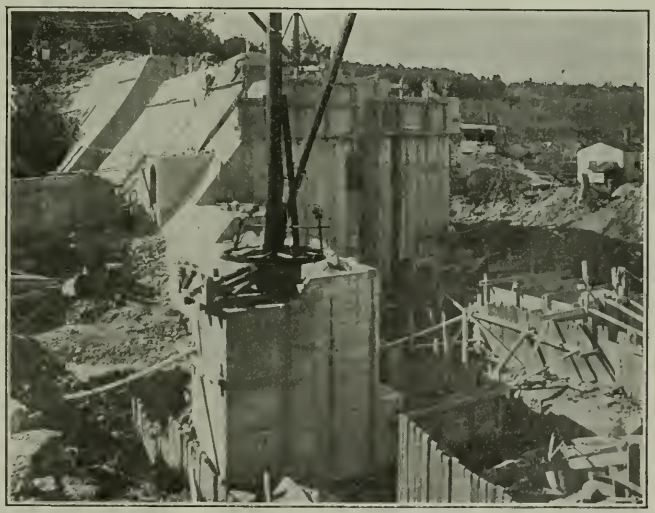
A home-made bag duster built on the general plan of an old time cylindrical carpet duster has added much to the comfort of employees engaged in bundling bags for return shipment to the cement mills. Incidentally it has helped salvage nearly enough cement to pay for its operation as well as having cut the weight of empty bag shipments in half. It has made it possible to return and get credit for nearly 96 per cent of the bags originally received.

The first concrete in this dam was placed in August, 1916, but due to the war and the shortage of help immediately following, but slight progress was made until the summer of 1921.

At the close of that season's operations about 65 per cent of the work was finished and another year ought to see the entire undertaking completed.

The dam was designed and its location determined by former city engineer Frederick A. McClure, under whose direction and supervision the construction was begun and nearly half finished.

Its construction has been under the joint supervision of the Engineering and Water Departments. George W. Batchelder, the water commissioner, has furnished all materials and supplies, while city engineer David M. Earle directs and supervises the work, assisted by Leon A. Goodale, who has served as superintendent since the beginning of the work.



DOWN STREAM FACE OF DAM, SHOWING INSPECTION GALLERY AND ENTRANCE TO IT. SHORT PILE COFFER DAMS IN FOREGROUND FOR UP AND DOWN STREAM SECTIONS OF FOUNDATIONS.

Miles Acid Process

Present Status of the process described by the Chief Chemist of the Sanitary District of Chicago. American tests and European plants. Economic and mechanical difficulties. Equipment necessary

Some months ago we described at length the Miles acid process of treating sewage, giving the results of tests that had been made by several investigators. An unprejudiced and clear statement of the present status of this method of treating sewage was presented in a paper before the Engineers' Society of Western Pennsylvania by F. W. Mohlman, chief chemist of the Sanitary District of Chicago. Some of the salient features of Mr. Mohlman's paper are abstracted below.

The patent for this treatment was taken out by G. W. Miles in 1915 and covers a "method of purifying sewage and recovering therefrom normally non-precipitant organic matter, which consists in introducing into the sewage before decomposition of the said organic matter has materially progressed: (1) an inorganic acid as the sole effective reagent. (2) An inorganic acid under conditions which preclude the formation of insoluble soaps. (3) Sulphurous acid. (4) Sulphur dioxide, thereby producing sulphurous acid."

The real step in advance marked by this patent is in the use of sulphur dioxide. Its advantages over sulphuric acid are that it produces an equivalent amount of effective acid at a lower cost; it is a more powerful bactericide than sulphuric acid, and solid brimstone is more portable and less dangerous to handle than sulphuric acid.

The use of sulphur dioxide had been attempted in England earlier than this (See article by Thorndike Saville in Public Works, Volume 50, pages 24 to 26), but whether this would affect the validity of the Miles patent Mr. Mohlman did not attempt to discuss.

THEORY OF THE PROCESS

The theory of the process is described by Mr. Mohlman as follows: "Normal domestic sewage is usually alkaline in reaction, due mainly to the bicarbonates of calcium and magnesium. It also contains a small amount of ammonium carbonate and varying amounts of calcium and magnesium soaps. These soaps have been formed from ordinary soap, which is the sodium salt of stearic, palmitic and oleic acids. Sodium soaps are soluble in distilled water, but when used with water containing calcium and magnesium salts, the sodium salt is changed to calcium and magnesium soaps which are insoluble in water and in organic solvents such as gasoline, solvent naphtha, or petroleum ether."

When an acid is added to sewage, the bicarbonates are first decomposed and then the insoluble soaps are more or less changed to free fatty acids. These would mechanically separate from the liquid and rise to the surface if they were present in concentrated form and the sewage were heated, but, highly diluted in cold sewage, they remain entrained in the settling particles of suspended solids. They are, however, soluble in organic solvents and may be extracted from the dried sludge.

Any mineral acid will effect these changes but sulphuric and sulphurous acids are the only ones economically practicable.

In addition to changing the insoluble to soluble salts, the sulphurous acid effects marked sterilizing actions. Another important advantage is the effect of the acid on colloids. If colloids are electrically charged they resist coagulation, but if the charge can be neutralized they can be coagulated. Colloids in sewage are usually negatively charged and the application of acids will add positively charged hydrogen ions. The principles of hydrogen-ion concentration have not been thoroughly worked out and the proper degree of acidity for securing the iso-electric point which will secure the maximum precipitation of colloids has not been determined.

Sludge obtained by the Miles process is very stable and may be kept for several days in hot weather without becoming septic. It also has a low moisture content, even to having a volume only two-thirds as great as sludge obtained by plain sedimentation.

TESTS AND EXPERIENCES

Mr. Mohlman described experiments made by E. S. Dorr in 1911 to 1914; those of Robert S. Weston in 1915; those by the Sanitary District of Chicago in 1914 and 1915; those by G. J. Requardt in Baltimore in 1915, and those of Professor C. E. A. Winslow in 1917 and 1918; all of which have been previously described in Public Works.

Only these experimental tests have been made in this country, but full size municipal plants have been operated in England and Germany. The best known plant is that at Bradford, Eng., where the grease content of the sewage is very high and the alkalinity very low, thus securing a large return of grease with comparatively low expense for acid. The sewage is treated with sulphuric acid and the resulting sludge, containing 15% to 20% solid matter, is treated with sulphuric acid and heated to the boiling point with live steam and filter pressed while hot and much of the grease thus removed. The filter press cake, however, still contains 15% to 20% grease. This and other plants were described by Thorndike Saville in the article in Public Works referred to above.

At the plant at Cassel, Germany, sludge from plain sedimentation basins was filter-pressed hot and extracted with benzol. This plant was abandoned on account of the excessive cost of drying and the objectionable odor of the grease obtained.

Summarizing all of the foreign work on acid treatment, Mr. Mohlman states that the concensus of opinion has been that the recovery of grease is a profitable undertaking when the sewage contains unusually large amounts of grease, but that with municipal sewages no profits could be hoped for under ordinary conditions. In this country, the Boston results indicated an apparent profit of $6 per million gallons; those at Chicago a substantial margin of profit over operating and fixed charges; those at Baltimore indicated that grease extraction would not be profitable, although it might permit the acid method to compete with other well-known proc-

esses; while the New Haven results indicated no hope of profit from the acid treatment, although the net cost was lower than that of Imhoff tank treatment or screening, followed by chlorination.

ECONOMIC AND MECHANICAL DIFFICULTIES

It will be noticed that all of the American tests were made from 1914 to 1917 or 1918 inclusive. In 1914, garbage grease was sold at about 6 cents a pound, and the price rose until it reached a maximum of 16 cents in 1918. Since then the price has declined rapidly and materially, and is now down to 2½ cents or less. A comparison of the grease obtained by the Miles acid process with that obtained by garbage reduction leads Mr. Mohlman to believe that, where there is any market at all for the former, it would not bring more than one-half to two-thirds as high a price. Conclusions as to the profitableness of the production and sale of grease by this process that are based upon prices of 6 to 16 cents a pound would apparently have very little value when the price has fallen to 2½ cents or less. In fact, Mr. Mohlman believes that at present sewage grease could not be sold at any price, several superintendents of garbage reduction plants finding difficulty in securing any market whatever for their garbage grease a few months ago.

One cause of the low value of sewage grease is the amount of unsaponifiable material in the grease. This was found to be from 15% to 28% in New Haven and 13.6% in Baltimore, whereas in good garbage grease this matter is usually less than 3%.

Inability to dispose of the grease, however, does not mean that the Miles process is unworthy of consideration as a practical method of treatment. "Under certain conditions where clarification and disinfection are required, where the alkalinity is low and where it is essential that no nuisance be produced, the Miles acid process is a worthy competitor of Imhoff tanks followed by chlorination. When economic conditions make it unprofitable to extract the grease, the sewage may be treated with sulphur dioxide, settled in tanks, and the sludge removed and either disposed of in liquid condition or filter pressed. Its low moisture content as taken from the tanks would reduce its bulk to approximately the same as Imhoff sludge, and it might be filter pressed if necessary to bring its moisture content lower." A high degree of disinfection is secured by the process and the effluent is quite clear. In addition, the stable condition of the sludge, the lack of septic action and odor around the plant and the absence of scum are points in favor of this process.

However, where the alkalinity of the sewage is high the cost for acid will be great. It does not produce a stable effluent and the sulphur dioxide uses up dissolved oxygen in the water in which the effluent is diluted. If the sewage contains iron, the acid treatment might tend to keep the iron in solution and possibly even dissolve iron which, upon neutralization with the bicarbonates in the stream, would precipitate and cause unsightly discoloration.

In addition to the doubt thrown upon the American conclusions of commercial value of the process, Mr. Mohlman states that many mechanical difficulties have been overlooked. He mentions seven of these as follows:

(1) Small-scale tests may have produced a sludge with a lower moisture content than can be obtained on a large scale.

(2) Filter pressing may not be as easy as is anticipated.

(3) If the sludge is not pressed but is fed into the driers directly from the tanks at 85% moisture it might ball and cake and not dry properly. Usual practice does not permit of the drying of sludge containing over 80% moisture.

(4) The liberation of sulphur dioxide in the drier may cause trouble.

(5) The sludge may be too compact and sticky for percolation, causing channeling and making it difficult to recover the solvent by "steaming out."

(6) The solvent may carry with it a large amount of colloidal organic matter in addition to the grease. These inert solids might be removed by centrifugal action, but this is not assured.

(7) Distillation of the grease may be almost impossible because of foaming, liberation of sulphur dioxide or excessive carbonization.

EQUIPMENT

Equipment for using the Miles process would comprise sulphur burners, absorption towers and tanks; and in addition to these, presses, driers and extractors if grease and tankage are to be recovered.

Sulphur dioxide could probably be produced more conveniently by burning brimstone rather than pyrites, on account of the freight costs, pyrites containing not over 53% of sulphur while brimstone contains 99%. Moreover, pyrites would produce large piles of cinder consisting of iron oxide.

For burning brimstone the most efficient type of apparatus is a rotating kiln similar to a cement kiln or direct-heat drier. For large plants the ordinary burners 3 feet in diameter and 8 feet long, with a capacity of 250 pounds of sulphur per hour, would probably be used. They are easily regulated and produce a uniform content of SO_2 in the exhaust air. For smaller plants the pan type of burner might be more suitable. This consists of a simple shallow fire pot into which the sulphur is fed from a hearth in front. These may have capacities as low as 100 pounds per 24 hours.

The absorption of SO_2 in the sewage is effected in a tower filled with some kind of porous material, such as pumice, quartz or coke, but preferably a uniform pottery grid. (Mr. Mohlman believes that coke towers would probably lead to trouble or clogging and give poor absorption.) The amount of sewage that would have to be pumped to the tower or passed through it would never need to exceed 5% of the total flow, this amount being then mixed with the general flow of sewage. The portion directy treated should be passed through a fine screen before treatment to prevent the clogging up of the material in the tower.

The raw sewage so treated could then be mixed with the remainder of the sewage in any sort of baffled mixing chamber, as the diffusion of the acid is rapid. From the mixing chamber the treated sewage then flows to settling tanks. Any form of tank should be satisfactory but special precautions must be taken to prevent action upon it by the acid. If it is of concrete, it should be covered with a thick

coat of acid-proof paint or asphalt. The sludge is comparatively inert and there would be practically no formation of gas, and therefore a double-deck settling tank would be unnecessary. However, the sludge should be removed at frequent intervals since the acid eventually is neutralized and the sludge may become septic, possibly in two or three weeks. A uniform removal is advisable and the author believes that Dorr thickeners would be exactly suited to this purpose as they require a negligible amount of power and produce a homogeneous, condensed sludge which may be removed whenever desired. Collection and removal of sludge from sumps is not considered feasible in tanks unless more than 10 feet deep. His experience leads him to feel confident that the moisture content of acid sludge such as that produced at New Haven could be reduced to 85% with Dorr thickeners and the expense would not be greater than that of Imhoff tanks, since the tank can be shallow and a 60 foot thickener can easily be driven by a 10 h.p. motor.

TREATMENT OF THE SLUDGE

Unfortunately no experimental work in the treatment of this sludge has been done on a large scale. If the sludge can be reduced to 85% moisture as taken from the tanks, it would probably be cheaper to dry it directly without filter pressing. If the content cannot be reduced below 90% it will be necessary to press it. As Miles acid sludge dries very quickly on sand beds it could probably be pressed readily, but it is possible that it might be advisable first to press it cold to remove the water and then to steam the presses and remove as much grease as possible in this way. Even if the latter practice were employed, the cake would probably contain 10% to 15% of grease on the dry basis, so that driers would be needed.

For drying, direct-heat driers must be used, as steam drying is too expensive. A drier with a long fire-box must be used and an indirect method of introducing the hot air into the rotating cylinder in order to prevent the sludge from catching fire. Several varieties of direct-indirect driers that now operate successfully on inflammable food products should be satisfactory for sludge drying. There might be trouble from balling or caking, but a way out of this could probably be found.

For extraction, horizontal revolving cylinders are used, having a filtering medium at one end and fitted with both closed and perforated steel coils. The sludge is first flooded with a low boiling gasoline as a solvent and the cylinder is closed and revolved for a short time, at first cold and afterwards heated by the closed coil. The solvent is then drawn off through the filter, taking with it the extracted grease, and more solvent is then added. When extraction has been carried as far as desired, as much of the solvent as possible is vaporized by the closed steam lines and live steam is then admitted and the charge in the tank is steamed out, the steam and solvent are collected and the steam condensed. The solvent is distilled from the grease in a specially designed still. The tankage is moistened by the steaming out and as removed from the extractor contains about 30% moisture, which must be reduced to 10% or less by drying before the tankage can be sold.

Although the grease must be distilled before it can be used for making soap or other purposes, it is preferable to sell it crude to a distiller of fatty acids.

GENERAL CONCLUSION

In conclusion, Mr. Mohlman believes that this process should be at least among those considered in connection with the various sewage disposal problems. Where clarification and disinfection are required, a brief investigation of the alkalinity and composition of the sewage will indicate whether or not it is commercially practicable. If it appears possible that grease extraction may be profitable, large-scale tests should be made to demonstrate the value of the grease recovered.

If it is probable that the grease cannot be extracted and sold at a profit, the acid process may still be compared with the combination of Imhoff tank and chlorination. Where trade wastes interfere with normal Imhoff tank digestion, as was the case at New Haven, acid treatment may be practically the only alternative. It may generally be depended upon to give a better effluent than that produced by an Imhoff tank or a plain sedimentation tank.

Los Angeles Vacation Camps

Probably no branch of the city's recreation work has brought such satisfactory results as has the division of municipal camps. Rather a variation to the prevalent idea of municipal recreation, it has opened a field of activity and advanced rapidly until Los Angeles is receiving, through its recreation department and United States Forestry Department, numerous inquiries relative to this interesting project. This form of municipal service might well be termed the climax. A little daily exercise or recreation is a fine thing, but there comes a time when most of us need an entire change and relaxation from the strenuous life. To meet this need the municipal camps have been established. Last year approximately 4,100 Los Angeles residents spent their Summer vacation at the city's camps.

There are two large camps operated during the Summer from June to October, and one smaller which is conducted as a week-end camp throughout the season. The two larger camps are located in the high mountains in San Bernardino county. Camp Seeley (established in 1914), consisting of twenty-five acres of timbered land, is nestled in Seeley Canyon at an elevation of 4,500 feet on the northern slope of the hills, fifteen miles north of San Bernardino. Camp Radford (established in 1918), comprising eighty-two acres of wooded land, is situated at an elevation of 6,000 feet on the southern slope of the Santa Ana Canyon, thirty miles northeast of Redlands. Both sites are ideal, with running streams, thickly wooded with pines, surrounded by high peaks, and easy of access. This, coupled with comfortable transportation, simple housing, good food and efficient management offers opportunity for the strenuous or quiet vacation, according to the wish of the most demanding vacationist.

The use of these camps is restricted to Los Angeles residents or owners of real estate in Los Angeles. The outings are arranged for periods of

one or two weeks each. Registration is made at the playground office where a special clerk handles all camp inquiries. The cost is adjusted to cover only operative expenses, such as transportation, food, housing, supplies and salaries. A two weeks' vacation last Summer cost from $6.50 to $12.50 for children and $14.25 for adults. This price covers expenses and leaves a small margin to meet depreciation. The buildings are rustic in appearance and of good construction, while the other equipment is very substantial. The outlay amounts to about $25,000 at each camp and includes a large rustic lodge, pow-wow center, about 65 cabins or rooms, kitchens, large dining-room, storage house, toilet buildings and facilities, swimming pool, storage reservoir, water system and modern sewage system.

The life of the camp is the interesting feature. The hikes, the swim, the sports, and the jolly evening camp fires all tend to break down barriers and weld together the several hundred campers, from all walks of life, into one big harmonious family. Many lasting friendships are formed around the big fire.—From annual message of Mayor George E. Tryer.

Use of Tar in Road Construction

From a pamphlet by the U. S. Bureau of Mines describing the various uses to which "tar and its simple crude derivitives" are being put

"The importance of tar as a commercial product has been emphasized during the past five or six years more than ever before." This is the opening sentence of an eighty-page pamphlet just published by the Bureau of Mines of the Department of the Interior, entitled "Preparation and Use of Tar and Its Simple Crude Derivatives." The pamphlet considers the sources, production, properties and distillation, and then the various uses to which it is put, such as timber preserving, fuel, roofing, paint, preservatives, etc. Among the uses is that as a road construction material. The discussion of this use is as follows:

Tars and tar products are fast replacing mineral-oil products for surfacing roads. This fact may be variously ascribed to the increasing supply of suitable tars, the decreasing supply of suitable mineral-oil products, increased appreciation and recognition of the suitability of tars, and the more general availability of tars in practically all parts of the country.

Lunge* reports that in Great Britain in 1907 there were only 100 miles of road covered with tar or tarry mixtures, whereas in 1908 there were 700 miles; in 1909, 3,000 miles; and in 1910, 7,000 miles of such road.

A number of specifications have been drawn up for the tar to be used for this purpose, a fact not at all surprising in view of tars being produced under so many different conditions, and the roadbed, surfacing materials, and traffic and climatic conditions differing widely from place to place. Road tars are used for various purposes, and may be applied in different ways to obtain a particular result—a further cause for the wide variance in specifications. They may be used as a binder in place of cement, as in bituminous macadam roads, for dust-settling purposes or for cementing material—grouting—in the construction of brick, stone, or wood-block pavements. Although the material used for these purposes is usually either a soft pitch or a refined tar, or a mixture of the two, it is quite generally termed "road tar."

A bituminous material such as tar and pitch is used on gravel and crushed-stone roads in several ways: First, it may be forced into the interstices between the stone after it is placed on the road; second, it may be thoroughly mixed with the stone or gravel before the latter is placed on the road (care being taken to avoid using an excess of it); and third, it may be applied to the surface of a finished gravel or broken-stone road with or without a final topping of coarse sand or fine gravel. The pavement produced by the first method cited is called bituminous macadam; that produced by the second method is known as bituminous concrete.

BITUMINOUS MACADAM

On a subgrade, prepared by the usual method of grading, draining and rolling, a base, or bottom course, of broken stone (1 to 3½ inch) is laid; after this has been rolled, a second course of broken stone, usually of somewhat smaller (1 to 1½ inch) size, is laid on top of it. The prepared "road tar" or pitch is forced into the interstices of the top layer, which is then covered with finely cut, one-fourth to three-fourths inch stone to fill all voids. After this surface is properly rolled, a final coat of similar bituminous material is applied, covered with fine gravel or screenings, and rolled. The pitch used for the top coat is softer than for the main binding material. The depth of each course is predetermined according to the kind and amount of traffic the road must bear. The binder is always applied hot—200° to 225° F.—and the amount used per square yard varies between 1¼ and 1¾ gallons, depending on the depth and on the size of stone. In preparing the final surface or "seal coat," one-third to three-fourths gallon of binder is used per square yard of road.

BITUMINOUS CONCRETE

Bituminous concrete pavement is prepared much like concrete pavement, except that the binding material is a bituminous substance instead of Portland cement. A first course of crushed rock is put down as for bituminous macadam; on top of this is laid a layer of mixed crushed rock and sand that has been thoroughly mixed or coated with a bituminous material (pitch). This layer is applied and rolled while hot. The pavement may be left in this condition, but much of it is given a "seal coat" by spreading a layer of the bituminous material (usually thinner and of lower specific gravity than the main binder) over the surface, covering it with fine gravel or coarse sand, and rolling. The size of stone ranges from one-fourth to 1½ inches, according to conditions, but the custom is to use the larger sizes in the thicker pavements. One specification requires a

* Lunge, George, Coal tar and ammonia. London. 1916, 739 pp.

mixture of 1 cubic yard of grit sand less than three-eighths inch and 3 cubic yards of broken stone, three-fourths to 1½ inches. The material must be thoroughly coated, during mixing, with the bituminous binder, and an appreciable excess of binder should be avoided. One specification requires that 18 gallons of it be used per cubic yard of stone, approximating 5 to 7½ per cent. by weight in the finished pavement, but others require 5 to 30 gallons per cubic yard of material treated. This mixing is always done hot at 180° to 300° F. and the mixture is delivered at about 150° F.

SURFACING FOR OLD ROADS

When old roads are repaired, it is often the practice to apply a "blanket" or "seal" coat to the surface after the necessary repairs are made. For this purpose, a heavy refined tar or soft pitch is suitable, and the amount used per square yard ranges from one-half to 1 gallon, according to the thickness of the coat and the condition of the surface to which it is applied.

ROAD PRESERVER AND DUST SETTLER

In the maintenance of roads, it is desirable in many places to apply periodically a thin layer of bituminous material to the surface. For this purpose, refined tar is often suitable. The tar is preferably applied hot, but sometimes is applied cold, in which event it must, of course, be thinner than a soft pitch in order to spread properly. Less than a gallon per square yard is used, and ordinarily but 0.2 gallon.

Such a coat retards the formation of dust. For this purpose, tar is superior to many of the oils that are sometimes recommended and sold as dust preventives. Prof. Agg* says that in oiling roads "there is some danger of introducing into the surface an oil that will act as a lubricant instead of as a binder, and in that event the road will become loose and rapidly develop pot holes and ruts under traffic. Considerable difficulty has been experienced throughout the United States from that source, and too much emphasis cannot be put on the importance of using a good asphaltic base oil or a suitable grade of tar." It is undoubtedly true that tar has less lubricating qualities and contains a greater proportion of bitumens—binding material—and has greater antiseptic and germicidal properties than most mineral oils. Consideration of the foregoing statements will indicate how prominent tar is to be as a road material; moreover, statistics show that the yearly production of coal tar is rapidly increasing, whereas the demand for mineral oils is growing faster than the supply, with prospects of higher prices. Tar is now sold at many works at a lower price per gallon than good mineral oil (road oil).

FACTORS RETARDING THE MORE EXTENSIVE USE OF ROAD TAR

General utilization of tar for road building and surfacing has been retarded by the promiscuous use of any and all grades of tar on all sorts of roads, without regard to climatic conditions or the condition of the road. Obtaining the best results requires the use of judgment Special care should be taken that tar is not applied to wet or frozen roads and that it is hot enough to be of the consistency most suitable for the particular road treated. When tar is spread thickly, under conditions that do not permit ready absorption, it may be spattered on automobiles and other vehicles to such an extent as to cause prejudice against all tar pavements. After crossing such a street afoot, people with white shoes are not apt to have a very kindly feeling toward tar as a road-surfacing material.

The best results are obtained when the road to be treated is dry, free from dust, and warm, and the tar used is water-free and hot.

SPECIFICATIONS FOR ROAD TARS

Specifications for these tars are made with the following intentions:

1. To avoid adulteration or dilution with inferior products.
2. To insure a bitumen content high enough for the purpose.
3. To reduce lubricating properties to a minimum.
4. To provide for the use of tars of the proper consistence only.
5. To avoid the use of tars that will cause rapid deterioration of the road.

As a complete discussion of the merits or defects of the various tars cannot be presented here, only their principal requirements are mentioned.

The specific gravity of a pure crude tar has considerable significance to a chemist and is one of the factors governing purchase; however, as mixing very light oils with pitch will yield a tarry mixture of any intermediate specific gravity, the specific gravity alone is not a reliable test. To prohibit this "cutting back" of pitch with light oils that are volatile and undesirable in a road tar, the loss on heating a sample to a given temperature in a distillation apparatus is limited to a given maximum. The addition of mineral oils is guarded against by stating the specific gravity of the fractions obtained on distillation, or by chemical tests. The specific gravity of high-boiling fractions from the distillation of coal tar is greater than 1.00, whereas the specific gravity of mineral fractions is less than 1.00. To insure a high enough bitumen content, the percentage of distillations residue above a defined temperature and the percentage of free carbon are limited. The lubricating properties are avoided by employing only those tars that do not contain any appreciable amount of paraffin oils, namely, tars of high specific gravity—Coal tars. Specifications also consider the fluidity (viscosity) of the tar at a given temperature and require that the tar be applied at the most suitable temperature.

Much has been said regarding the free carbon and the naphthalene content of road tars Some difference of opinion exists as to the maximum amounts permissible and as to the minimum amount of free carbon that will be tolerated It is generally agreed that a great excess of either naphthalene or carbon is detrimental, and should not be allowed. Tars with very small content of free carbon are frequently inferior to those with a moderate content. The upper limit sometimes set for the free carbon content of tars used as binder is 25 per cent. and the lower limit is frequently 12 per cent.

* Agg, T. R., The construction of roads and pavements. New York. 1916, 432 pp.

For hot surfacing the limits are 22 and 10 per cent. (Here are given the specifications of the American Society for Municipal Improvements.)

REQUISITES FOR ROAD-DUST SETTLERS

The very light tars are most suitable for road-dust settlers. The free carbon should be very low, the lower the better, usually, and water and naphtha should be removed. Water-gas tars are good for this purpose As the surface on which the tar is to be applied must be considered, it is evident that specifications might require anything from a crude to a highly refined or specially prepared tar.

Frequent changes in specifications have resulted from the experiments that are being carried on continually with various tar preparations. Specifications for such materials that have been used with success have been published by the U. S. Department or Agriculture.* These are not represented as "standard" but as "typical" specifications. In general a tar from which the fraction boiling below 150° to 170° C. has been distilled off makes a suitable material for a primer or surface coat on macadam, gravel, or shell roads, especially if the tar contains a rather low percentage of free carbon High-boiling fractions are sometimes added to increase the fluidity of the product and decrease its content of free carbon. Methods of "meeting" specifications are mentioned in a later section of this paper.

When surface coats and dust preventives are applied care should always be taken to see that the road is dry and free from accumulations of dust and dirt. It is best to sweep the road clean before treating it.

* Hubbard, Prévost, and Reeve, C.S., Typical specifications for bituminous road materials: Bull. 691, U. S. Dept. of Agriculture, 1918, 60 pp.

American Water Works Convention*

Continuation of account of the meetings of the American Water Works Association held in Philadelphia last month

On Wednesday evening J. W. Ledoux read a quite exhaustive paper on wood pipe, giving the formulas for calculating strength of pipe and of bands, data concerning age, etc.; his general conclusion being that, even allowing wood pipe only one-quarter the age of cast iron, its use would be cheaper in the long run under those conditions that were favorable to it. An abstract of this paper will be published by PUBLIC WORKS in a few weeks. In discussing this J. N. Chester said that it was necessary to use no sap wood and in fact the precautions necessary in using wood pipe were so numerous and vital that in general he would say not to use it at all in a distribution system or in a pumping main. He named three cities which, although they had considerable wood pipe, required it to be taken up whenever a street was to be paved.

*Continued from page 381.

J. E. Gibson of Charleston, S. C., showed some samples of pipe which they have just begun making in which the cast iron pipe is lined with natural cement to a thickness of 3/16 inch to 1/4 inch in order to prevent tuberculation; the lining being applied in the manner that has been used for years in making cement-lined service pipe in Massachusetts, using a metal cylinder with a cone-shaped front end, which is drawn through the pipe and compresses the cement against the walls. He stated that in tapping these mains, the cement was pushed off in a cone-shaped opening, but did not uncover the iron around the hole.

The report of the Committee on Standard Specifications for Cast Iron Pipe and Specials was presented by the chairman, F. A. Barbour. He said that the manufacturers deserve great commendation for the willingness with which they co-operated with the engineering committees of this society and the New England Water Works Association. There was little that was new to report on the subject, but he stated that the matter of coating for cast iron pipe was in a far from satisfactory condition. Although specifications called for coal tar pitch varnish, the material used is generally neither pitch nor varnish but is usually coal or water gas tar from which some of the desirable constituents have been withdrawn or are absent, and this is frequently heated too high by the pipe, giving a brittle coating, this being especially the case with large pipes which retain their high temperature for a considerable time.

C. E. Inman read a paper giving "Experiences with Cast Iron Water Pipe for Pressures Higher than Allowed by Current Specifications," giving several illustrations of the use of Class A pipe where the pressures were those calling for Class B or even Class C, this being especially the case with 6-inch pipe. In discussing this a number of the older members stated that they had for years laid and still lay Class A 6-inch pipe for pressures over 100 pounds. Mr. Chester cited instances of some 6-inch Class B pipe under 300 pounds pressure, and none under this or any of the lower pressures had given any more trouble than any other pipes in the system. William F. Wilcox stated that he had had similar experiences with Class B 6-inch pipe in Birmingham and vicinity.

The method of making centrifugally cast iron pipe was discussed by Peter Gillespie, with illustrations with motion pictures and lantern slides. As has previously been told in PUBLIC WORKS, this pipe has been used for several years in Canada. The United States Cast Iron Pipe and Foundry Co. have the patent rights for this country and have begun manufacturing it, although they are not yet quite ready to furnish it for the market. A sample of pipe manufactured by them and sawed in two was shown in the exhibit hall. It was stated that, although the pipe weighed a little more than half as much as the ordinary cast iron pipe for the same pressure, it was fully as strong if not stronger, also the cost would be about the same per foot owing to the more expensive manufacture. There would, however, be a saving in freight and in handling by the contractor or city.

Two additional features of the evening session not on the program were a paper by Leonard Metcalf and a brief talk by E. J. Mehren. Mr. Mehren

spoke on the American Construction Counsel, an organization in which it is proposed to unite all of the agencies concerned in construction work, including architects, engineers, contractors, materialmen, municipal, state and federal officials, etc., and an invitation was extended to the American Water Works Association to become a charter member. The dues it was proposed to make $100 a year for each organization. The matter was left to the decision of the executive committee, but the members present voted that it was the sense of the convention that it would be desirable to join the council.

Mr. Metcalf read a paper giving further data concerning the cost of operating water works and the incomes of water works during the past two years, supplementing similar data given by him two years ago. This paper was published in last week's issue.

THURSDAY SESSIONS

Thursday was Superintendents' Day and was perhaps the most successful superintendents' day which the society has yet held, the sessions not being interfered with by matters not directly connected with discussion of operating matters and the discussion being quite general and well continued.

L. N. Enslow described the method of controlling the application of chlorine to water supplies in Virginia, with a practical demonstration of the operation, using orthotoledin as a reagent in carrying out the excess method. The general method was to apply 0.2 part per million excess chlorine, over and above that shown by the test to be absorbed, to secure the bacterial effect. This was followed by considerable discussion by superintendents, chiefly in the form of questions. One member stated that he did not believe that the ordinary water works superintendent was competent to apply the test, but in answer to this several engineers whose experience covered a large number of plants stated that as a matter of fact superintendents did use the test successfully and without difficulty.

G. Gale Dixon, chairman of the Committee on Physical Standards for Distribution Systems, presented the report of the committee, one of the chief features of which was the recommendation of a terminology. He stated that considerable improvement was needed in the knowledge and application of hydraulics and economic design of distribution systems, the knowledge of which appeared to be quite hazy. Some of the terms recommended were: Supply mains and distribution mains, the latter being divided into primary feeders, secondary feeders and distributors. (Incidentally Mr. Hazen suggested the use of reticulators instead of distributors, the former being the English term.) Some of the questions that Mr. Dixon considered to need investigation and which their committee hoped to investigate were as follows: The laws of head in primary feeders; practical limit in size of cast iron pipe before beginning the use of steel pipe; the maximum size of pipe that should be tapped for house connections; the maximum size of private fire connections that should be permitted; the satisfactoriness or otherwise of lead substitutes for joints; methods of making bridge crossings; methods of laying mains under railroad tracks; testing the joints of pipes before backfilling; the use of valves smaller than the mains; use of extension stems on valves; advisability of keeping large valves partly closed; whether the street corner is the best location for fire hydrants; advisability of using check valves between zones in a distributing system; the use of air valves, relief valves and pressure reducing valves; the loss of capacity of mains with age; the minimum working pressures for distribution systems. In the matter of the use of valves smaller than the mains it was suggested that this would interfere with cleaning mains later on. It was stated that New York City has adopted this practice and uses only four sizes of valves in its distribution system.

The use of air and relief valves was discussed by M. N. Borden, who described at some length the disadvantages of allowing air to collect in mains and the probability of its doing so under certain conditions. He stated that under 150 pounds pressure air would leak through lead joints that were tight to water. Air is apt to leave the water as pressure falls and to collect near summits in the pipe. It is also found especially abundant a short distance beyond where it leaves pumps. Air valves are therefore desirable near pumping plants and at all summits. Relief valves are desirable where there are sudden or undesirable pressures coming upon the mains; for instance on a main feeding a locomotive crane or other appliance likely to produce water hammer. In the former case he recommended a surge tank. He also referred to the desirability of relief valves on domestic services where check valves are applied next to the meter.

Dr. W. P. Mason gave a talk on the value of a sanitary survey which he described as being as necessary to prescribing for a water system as a personal examination of a patient was desirable for a physician. He cited one instance where samples sent from a set of wells 125 feet deep were reported as containing B-coli at times, which might have led to the condemnation of the supply. A personal inspection, however, showed that the soil was sandy and there were no houses near enough to endanger the supply and apparently no opportunity for pollution. In view of these facts and of the fact that B-coli has been found where no human pollution was possible and that the tests of the samples had been made in hot weather, the samples not having been on ice; he believes the condemnation of the supply would have been entirely unjustified, and yet would have been ordered but for the sanitary survey.

In discussing the "Causes of Failure of Cast Iron Pipe," F. A. McInnes stated that the most common cause in Boston was undoubtedly a rigid bearing, such as the pipe resting on a rock, but especially, in Boston at least, on other structures which had been built underneath the mains and in contact with them, the disturbed soil nearby under the main having settled and thus required the main to act as a beam. In addition, he believed that the quality of the iron was not sufficiently protected. Of 2,100 test bars broken, 40 per cent of these showed less than .3 of an inch deflection, the range being from .22 inches to .37 inches. Sulphur also he considered to be an important consideration. Samples of iron from broken pipes, of which he gave quite a long list, showed from .133 to .23 parts of sulphur.

(To be continued)

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Supervision of Sewage Treatment Plants

"The sewage treatment plants that I have come into contact with are in nearly 100 per cent. of the cases neglected, unsupervised and unnoticed. Usually there is no one whose duty it is to operate the plants and they are supposed to be self-operating by the town officials. This is often due, I believe, to the impression left by the constructing engineer that no attention is needed."

This statement was made to the writer recently by the sanitary engineer of the state board of health of a southern state. Unfortunately the condition described is by no means confined to that state. A few weeks ago we quoted the state sanitary engineer of an upper Mississippi Valley state as saying that the best that could be said for most of the plants in his state was that they "did the sewage no harm."

Criticism of this too common state of affairs is not new—we have made similar comments before—and we propose to continue making them and citing examples that illustrate this most objectionable condition so long as legislators fail to provide some remedy by giving to state health boards or other competent state or federal bodies power to compel the proper operation of each plant and the securing thereby of at least an approximation to the amelioration of conditions which was the aim of such plants.

The American Construction Council

The purpose of this organization is " to place the construction industry on a high plane of integrity and efficiency." A short creed, but one that covers the whole field and, fully consummated, means little less than universal peace and prosperity.

It visions industry, economy, honesty and wise investment everywhere; fairness and co-operation between employer and employee; and steady occupation with fair reward for both labor and capital.

It means safety from profiteering, broken contracts, extortion and conspiracy, and unbalanced remuneration, that have infected the world and wasted its resources, and when this has been effected or even notably advanced it will compel corresponding conditions in general industries, production, commerce and finance.

The tasks of organization and, much more difficult, of execution, will be slow and costly. They must be voluntary, earnest and persistent; they must be inspired by broad altruism and supported by a certain amount of material resources and then they must be vigorously and practically endorsed by every honest man, as they will surely be opposed by the selfish, dishonest and lazy ones who create, agitate and inflame dissensions to serve their own greed.

The council will be representative of the widest interests involved, including engineers, manufacturers, dealers, labor, financiers, public officials, great enterprises and government departments. It will take up ethics, researches, statistics, standardization, elimination of waste, steady employment, apprenticeship and other vital factors of construction.

The organization of the council is to take place on June 19th and 20th, and an invitation to it is published on page 408. Further reference to the council will be found on page 406.

Road Building and Malaria

The task of eradicating malaria has been made more difficult by the fact that railway and highway construction is continually creating new pools that serve as breeding spots. Assistant Surgeon General Carter found that probably three-quarters of the malaria in one district in eastern Virginia came from such artificial pools. It is hoped to avoid anything of this kind in construction of highways under Federal aid, the specifications requiring that the culverts on federal aid roads be so placed that they will completely drain all wet areas above the culvert entrance and that all borrow pits or excavations made along the roadways be filled or properly drained. Many southern states have enacted laws of similar purpose.

If attention be paid to this matter when roads are being built, adequate drainage can be had then with very little if any additional cost, whereas if culverts are placed too high or borrow pits are not properly drained, the expense for later rectification may be very great. The state highway engineer of Alabama recently appealed strongly to all engineers and other officials to co-operate in this matter and every community, especially in the south, should take particular interest in the subject, avoiding creating such spots themselves and reporting the whereabouts of any that are being created in their vicinity.

Invitation to First Meeting of Construction Council

The following is called to the attention of readers of *Public Works* at the request of General Marshall:

Lacking facilities at present for direct communication with the thousands of important men in the construction industry, the temporary directing committee of the American Construction Council begs leave through the columns of the engineering, architectural and construction press to extend a personal invitation to each member of the industry to attend the organizing meeting in Washington, D. C., June 19 and 20.

The step contemplated, that of bringing together for cooperation in behalf of the industry and of the public all the elements of construction activity—engineers, architects, labor, the contractors, the manufacturers and dealers, and the financial interests—is epochal in American industry. It deserves, and promises to have, the full support of the entire industry. A full representation at the organizing meeting will be the best testimony to the country of the solidarity of construction interests in the new movement.

Full details of the plan are set forth in a comprehensive pamphlet, procurable from the temporary office, 1053 Munsey Building, Washington, D. C. The meeting will be held in the Washington Hotel. Mr. Hoover will preside.

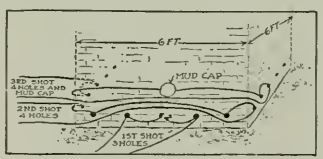
Temporary Directing Committee, American Construction Council
R. C. Marshall, Jr.

Dynamiting an 80-Foot Brick Stack

A brick smoke stack about 80 feet high was built some time ago at Glen Gardner, New Jersey, and having become dilapidated, was in a precarious condition endangering adjacent structures on which it might fall if blown down by a high wind.

The lowest bid received for tearing it down was $1,100 and some contractors invited to bid refused on account of the dangerous nature of the work. Under the direction of C. E. Weaver, Erie, Pa., of the DuPont Co., it was easily and safely razed by dynamite.

Holes 1 3/8 inches in diameter and 12 inches long were drilled horizontally in the base of the stack, five holes on each of three adjacent sides. In order to avoid shaking the stack too violently, the blasting was done progressively with successive rounds as indicated in the accompanying diagram. The holes were each loaded with a half stick of 30 per cent. Red Cross Extra dynamite, of which six pounds were required, which, with the blasting caps, cost less than $3.00. All of the shots were fired by electricity.



LOCATING HOLES FOR DYNAMITE CHARGES FIRED IN THREE SHOTS

The first and second rounds were fired on the side towards which the chimney was required to fall and weakened it without overthrowing or splitting the stack. After the second round had been fired a two-pound mudcap charge was placed in the center of the weakened side and, together with the remaining holes, was fired without smashing the stack which, remaining still intact, first began to lean in the required direction and finally gathered momentum and fell to the predetermined point in the open field without damaging any other structure. No compensation for his services was accepted by the DuPont technical representative.

How to Handle Concrete Piles 80 Feet Long

Hooks provided in the sides of pile to engage slots in a steel carrying truss that has two alternate connections to hoist and permits horizontal, vertical or inclined position of pile without developing injurious stresses.

Editor Public Works, Sir:

We are taking advantage of your offer in a recent number of Public Works to avail ourselves of your assistance in our construction problems.

We are enclosing a blue print of a hollow pre-cast concrete pile which is to be used in the construction of a bridge. Our problem will be the handling of these piles after they have been pre-cast and seasoned to the location of the pile driver and then getting them into the leads without injuring the pile. The piles will require to be seasoned for thirty days after pouring. We expect to pour these piles horizontally, using wooden forms and a 28-inch gauge metal core, leaving the core in the pile. At the bottom end of the pile we will leave in a 2-inch piece of galvanized pipe for the purpose of jetting. As the majority of the material that the pile is to pass through is vegetable muck we do not anticipate any trouble in jetting down that far and for the remaining 10 feet, think that a few blows with the hammer assisted by the water pressure will carry the pile down to the necessary depth.

We would appreciate having your ideas, however, as to the best method of lifting these piles into the leads and how it is best to arrange our slings so as to have the minimum amount of breakage.

——————— Company.

The plans submitted show that there are required for the job 358 piles of an average length of 80 feet and a uniform octagonal cross-section inscribed in a 20-inch square and having walls with a minimum thickness of 4 inches. The lower end of the pile is tapered in 2 feet to a thickness of 6 inches and, except for the jet pipe, is solid for a distance of 18 inches from the point. The pile is reinforced by eight 1-inch steel bars parallel to the axis that runs the full length from the top of the pile to the commencement of the taper, beyond which four of them are cut off and four are bent and continued to the point. The bars are wired to a spiral coil of 1/4-inch rods, wound to a pitch of three inches for 4 or 5 feet at top and bottom and to a pitch of 6 inches intermediately.

The piles are driven in seventeen transverse bents and in four tiers, and are vertical except a few at the ends of the bents which are battered. They all are driven through a thick bed of muck to penetration in coarse gravel which in some cases is overlaid with fine sand up to 20 feet deep. The penetration in the gravel varies from a few inches to about 15 feet maximum.

Owing to the thickness and weight of these units

and their comparatively narrow width, careless and improper handling would be likely to develop very heavy stresses that would break or crack the concrete. This can easily be prevented by giving them proper support and carefully avoiding impact.

As there is a large number of piles, it will probably be necessary to move them from the casting floor to storage and leave them there for some time, during the period of seasoning. Although it would be possible to handle them safely when only a few days old, by means of locomotive cranes, derricks or their equivalent, it would be more simple and safe to move them from the casting floor to the seasoning skids without lifting. This operation will be facilitated if the bottoms of the forms are made detachable and the piles allowed to remain on them while seasoning.

If the piles are cast in a single tier, a number of parallel horizontal or slightly inclined rails can be set under the forms and the piles safely pushed over them to position in storage without removing them from the bottom pieces of the forms.

If it is desirable to remove the bottoms of the forms when the piles are only a few days old, the latter may be rolled 45 degrees to take bearing on long planks or short cushion pieces supported on rails or pairs of rails not more than 10 feet apart and transverse to the axis of the pile; after which the pile can be skidded on the cushions of planks to the required position or transferred to carefully prepared bearings on trucks or on cars transferring them to the storage yard where they may be skidded off.

If it is permissible for these piles to remain a week or ten days on the casting floor, they may at the end of that time be safely handled without skidding by use of a locomotive crane, derrick or traveler. In this case it will be necessary to provide rigid support for the piles at several intermediate points to prevent undue flexure when the axis of the pile is in a horizontal or inclined position. This can be secured by various combinations of slings, bridles, evening bars, trusses, cradles, or possibly by an interior mandrel, but the latter would, on account of its small diameter, necessarily be so heavy that it would not be very convenient or advantageous.

Piles up to 40 feet long with the reinforcement that these have, could, however, be handled by a mandrel or by simple slings or bridles arranged to give them support at about the quarter points, and allowed to turn freely from horizontal to vertical position in the hoisting tackle.

This would not be satisfactory for the maximum lengths of piles and as these can be handled by a simple rigid device, the latter may as well be made suitable for lifting shorter lengths as well, and thus use a uniform method throughout. It is important that in horizontal position the piles should be supported without excessive overhang at either end and without long spans between points of support, and that the supports should be positive, uniform, with little clearance, easily attached and disengaged, that they should provide abundant rigidity and should always be attached to the piles at exactly the same places and in the same manner.

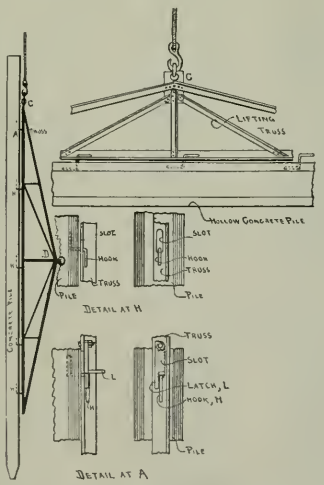
To accomplish this, a simple method is to cast in the upper surface of the pile, several short rods bent to a Z-shape, one end projecting a fraction of an inch clear of the outer face and parallel to the axis of the pile or slightly divergent from it, thus forming a series of parallel hooks, marked H, H, H, spaced exactly the same distance apart on all piles, varying the length of the overhang or the number of hooks for different pile lengths.

A light steel truss, conveniently made of single angles riveted together, should be designed 10 or 20 feet shorter than the longest pile and provided with an attachment C for hoisting tackle at one end and an attachment D for hoisting tackle at the center of the top chord. The outstanding flange of the lower chord should be slotted to correspond with the faces of the hooks embedded in the concrete pile so that when the lower chord of the truss is parallel to the axis of the pile, the outstanding legs of the hooks will register with the slots in the truss and pass through them, after which the short longitudinal displacement of the truss will give the stems of the hooks bearing against the ends of the slots and the truss can be locked in position by means of the pivoted latch L at the end of the truss at A which can be revolved by its projecting bent end and will prevent any displacement of the truss relative to the pile.

If there is a clearance of more than 1/4-inch between the hooks and the truss lower chord angle which they engage, it should be filled by wedges driven to bring all the hooks to uniform solid bearing. If the hooks fit accurately and uniformly a slight clearance will not be injurious.

The pile can then be lifted to a horizontal position by any convenient hoisting tackle connected to the center of the top chord at C or by a bridle rope attached to the hoisting line, the ends of the bridle being attached to the connections at C and D, thus enabling the bridle to render freely through a sheave in its bight that supports it and permits the pile to be revolved in the bridle to any required position.

The piles can thus be hoisted or lowered in a vertical position or lowered in a horizontal position for



STEEL TRUSS ENGAGING HOOKS CAST INTO FACE OF PILE

storage or transportation, and when the hoist-line is slacked and the latch disengaged, the truss can be displaced longitudinally far enough to make the projecting hooks register the full length of the slots and the truss can be lifted off and removed quickly and safely.

To place the piles in the leads of the pile driver, the truss should then be again engaged with the pile hooks, locked into position and lifted either with the bridle or with two lines attached to points C and D and line D operated while line C is overhauled until the pile assumes a vertical position and is swung to place and lowered to bottom, when the trus can easily be removed and used for handling another pile and so on.

The section modulus of the piles should be calculated, the moment of flexure computed for the support of the piles at different points and the hooks should be placed close enough to keep the maximum stresses down to say 500 pounds per square inch in compression, and the tensile stress in the reinforcement rods in the pile down to 8,000 or 10,000 pounds per square inch. The maximum distance between hooks will thus be found and some uniform smaller spacing and corresponding number of hooks selected to secure uniform arrangement for all lengths of piles so that the one truss will fit all cases.

There have been several instances of very long concrete piles, notably those driven in San Francisco Harbor and those driven by the MacArthur-Perks Company in Havana and those driven in other places, some of which have been reinforced to resist bending moments due to their dead weight in any position; others have been handled by carefully restricted attachments made with eyes or loops cast in the concrete at regular positions in the side of the piles, insuring the attachments of lines or tackles at fixed points so that only the predetermined stresses should be developed.

Although this method has been successfully used for rapid work and for positive elimination of heavy and uncertain stresses, the same results can be secured by the use of a truss which for a large number of piles involves only a very trifling cost for each pile and will permit the work to be done more rapidly and conveniently.

Methods of Paying for Paving

How much assesed on abutting property and how much paid by city; methods of calculating assessments; how funds are obtained
Supplementing tables published in the May 13th issue

Name of City	Percentage of paving cost: Assessed on abutting property	Percentage of paving cost: Paid by city	Methods of calculating assessments	Payable in how many installments	Funds obtained by city by	Life of bonds, years
Alabama						
Bessemer	....	⅓	By front foot	10	bonds	10
Fairfield	all	none	By front foot	10	....	10
Arizona						
Bisbee	....	all	.....	....	bonds	20 yr. serials
Clifton	....	all	.....	....	budget & bonds	20
Prescott	all	....	1920 front ft., 1922 area	10	budget	10
Yuma	all	....	Frontage, incl. intersections	10	....	....
Arkansas						
Paragould	....	none	Dist. pays as assessed benefits	15	....	15
California						
Alhambra	all	....	Front foot	Paid on completion of work	budget	10
Bakersfield	all	....	.....	....	....	....
Chico	all	....	Front., intersect. in prop. to areas	15	both	15
Modesto	all	....	Front foot and area	14	bonds	30-40
Monrovia	all	....	Front foot	10	budget for rep.	....
Oroville	....	....	On front., intersections prorated	....	bonds	10
Richmond	all	none	Acc. to benefits	6-10	budget for rep.	....
Santa Monica	all	....	Front ft., acc. to benefits	10	....	10
Colorado						
Colorado Springs	50%	....	Zone system	14	bonds	12 yr. serial
Montrose	all	....	Front foot	15	....	10-15
Connecticut						
Ansonia	....	all	.....	....	budget	....
Bridgeport	½	....	Front foot	1	bonds	5
Derby	none	....	.....	....	budget	....
New Canaan	....	....	.....	2	special tax	....
Stamford	½	....	½ on all but tar mac., by front foot, excl. intersections	....	both	20 yr. serial
Dist. of Columbia						
Washington	½	....	Front ft., excl. intersections	3	budget	....
Florida						
Jacksonville	⅔	⅓	Front ft., incl. intersections	....	bond	10-30
Georgia						
Brunswick	....	⅓	Front foot	3	budget	....
Idaho						
Idaho Falls	....	....	By area of lot, intersect'ns by city	20	bonds	20
Pocatello	all	....	Front ft., excl. intersections	10	bonds	10-20
Illinois						
Chicago	all	....	Frontage	5	....	....
Freeport	all	....	Front ft., excl. intersections	10	bonds	10
Oak Park	all	....	Front foot	5-10	budget	....
Indiana						
Bicknell	all	....	Front ft., excl. intersections	10	both	10
Logansport	all	....	Area of lots excl. intersections	10	both	10-20
Newcastle	all	....	Front ft., excl. intersections	10	budget	....
Wabash	all	....	Front ft., excl. intersections	10	budget & war.	....

Table No. 3—Methods for Paying for Paving—(Continued)

Name of City	Percentage of paving cost: Assessed on abutting property	Percentage of paving cost: Paid by city	Methods of calculating assessments	Payable in how many installments	Funds obtained by city by	Life of bonds, years
Iowa						
Creston	all	....	Area and benefits	10	bonds	1-10
Denison	all	....	Area	7	....	....
Le Mars	all	....	Area, incl. intersections	10	....	....
Waverly	all	....	Front foot	10	budget	....
Kansas						
Independence	....	....	Assessed value of ground in district, city pays intersections	10	bonds	10
Manhattan	all	....	Front ft., excl. intersections	10	bonds	10
Kentucky						
Frankfort	⅔	⅓	Front ft., excl. intersections	10	budget	....
Ludlow	all	....	Front ft., excl. intersections	1	budget	....
Madisonville	all	....	Front ft., excl. intersections	10	budget	....
Paducah	all	....	Front ft., excl. intersections	10	bonds	10
Shepherdsville	....	all	.....	....	....	....
Louisiana						
New Orleans	....	all	Foot frontage	10	budget	10
South Highlands	all	....	Front foot	4	....	....
Maine						
Lewiston	....	all	.....	....	....	....
Rockland	....	all	.....	....	budget	....
South Portland	....	all	½ for cement walks	....	budget	....
Maryland						
Baltimore	1/6	5/6	By front foot	10	loans	....
Easton	½	½	By front foot	when complete	both	....
Hagerstown	....	all	.....	....	budget	....
Massachusetts						
Boston	½	½	Area of lot	10	loans & taxes	20
Brookline	none	....	.....	....	budget	....
Danvers	....	all	.....	....	both	5
Gardner	....	all	.....	....	bonds	10-20
Greenfield	....	all	.....	....	bonds	4
Lee	....	all	.....	....	both	1-3
Malden	....	all	.....	....	bonds	....
New Bedford	....	all	.....	....	bonds	life of impv.
Newton	all	....	Front foot	10	bonds	10
Peabody	....	all	.....	....	both	10
Reading	....	all	.....	....	budget	....
Revere	....	all	.....	....	bonds	10
Taunton	....	....	.....	....	bonds	5-10
Waltham	½	½	Front foot	10	bonds	5-10
Watertown	....	all	New sts. by abutter by front ft.	1-10	both	....
Worcester	....	all	.....	....	budget	....
Michigan						
Flint	all	....	Front ft., area, excl. intersects.	5	bonds	10
Kalamazoo	all	....	Benefit	10	budget	....
Menominee	....	½	Front ft., excl. intersections	5	both	....
Munising	⅔	⅓	Front ft., excl. intersections	1	budget	....
Muskegon	all	....	Front ft., excl. intersections	10	budget	10
Port Huron	all	....	Front ft., excl. intersections	12	bonds	....
Saginaw	....	30%	Front ft. area, etc., excl. intersec.	10	both	10
Minnesota						
Duluth	all	....	Front ft. area, etc., excl. intersec.	5	both	....
Fairmont	all	....	Front foot	15	....	1-15
Farmington	all	....	Front ft., excl. intersections	....	....	....
Luverne	all	....	Benefits	up to 20	....	10-20
Minneapolis	....	⅓	Front foot	10-20	bonds	10-20
Virginia	40%	60%	Front ft., excl. intersections	5	budget	....
Mississippi						
McComb	all	....	Except intersections	10	bonds	10
Vicksburg	⅔	⅓	Front ft., intersections by city	10	both	....
Missonri						
Cape Girardeau	all	....	Front foot, area	5	....	....
Monett	75%	....	Front foot	5	budget	....
Montana						
Billings	all	....	Area of lots	12-20	....	....
New Jersey						
Camden	⅔	⅓	Frontage, intersections by city	10	both	serial
Roselle Park	50%	50%	Frontage, excl. intersections	10	bonds	10
Rutherford	⅔	⅓	Frontage, excl. intersections	5	notes	life of impv.
South Orange	⅔	⅓	Frontage, excl. intersections	10	bonds	10-20
Westfield	67%	33%	.....	10	bonds	10-20
West New York	....	25-35%	Front foot	10	bonds	15
New Mexico						
Clovis	all	....	Front ft., incl. intersections	10	....	9
Santa Fe	all	....	Front foot	10	....	10
New York						
Amsterdam	50%	50%	Front ft.—30% area of intersections charged to No. lin. ft. on st.	3	budget	....
Auburn	50%	50%	Front footage	10	Bonds	10
Carthage	½	½	Front foot	1	Bonds	20
Endicott	25%	75%	Front foot	2	Bonds	1-20
Jamestown	all	....	Front ft., excl. intersections	10	Bonds	10
Johnson City	50%	50%	Front foot	3	Bonds	5-15
Malone	....	all	.....	....	budget	....
New York City						
Bronx	all	....	Repav. by city. Front foot	10	Bonds	....
Brooklyn	....	....	Percentage assessed determined by Bd. Est. & Apportionment	10	Bonds	5-50
Manhattan	all	....	Front ft. Repav. by gen. tax levy	10	both	10
Queens	all	....	By lot ft.	10	both	....
Richmond	all	....	Area of lot	10	Bonds	10

Table No. 3—Methods for Paying for Paving—(Continued)

Name of City	Percentage of paving cost: Assessed on abutting property	Percentage of paving cost: Paid by city	Methods of Calculating assessments	Payable in how many installments	Funds obtained by city by	Life of bonds, years
New York (Continued)						
Norwich	⅓	....	Front foot	5	Bonds	20 yr. serial
Saranac Lake	⅔	⅓	Front ft., incl. intersections	10	both	10
Troy	50%	50%	Front ft., incl. intersections	3	Bonds	life of impvt.
Waverly	c. & gut.	rest	Lot frontage	....	budget	....
North Carolina						
Durham	⅔	⅓	Front ft., excl. intersections	10	Bonds	....
Washington	50%	50%	Front foot	10	Bonds	10
North Dakota						
Grand Forks City	80%	20%	Benefits	20	budget	20
Ohio						
Ashland	98%	2%	Front ft., excl. intersections	20	Bonds	10
Barberton	98%	2%	Front ft., excl. intersections	10	....	10
Bellefontaine	98%	2%	Front ft., excl. intersections	10	Bonds	10
Canton	98%	....	Front ft., excl. intersections	10	Bonds	serially
Chillicothe	98%	....	Front ft., excl. intersections	10	Bonds	10
Circleville	....	....	.....	10	Bonds	10
Dayton	98%	2%	Front ft., incl. intersections	10	Bonds	20
East Cleveland	98%	2%	Benefits; 50% intersections on repair	10-5	Bonds	10
Newark	98%	2%	Front foot	20	Bonds	10
Painesville	98%	2%	Front ft., excl. intersections	10	Bonds	10
Perrysburg	98%	2%	Benefits	10	Bonds	5-20
South Point	10%	15%	Rest by state & county on 50-50 basis. By front foot	10	budget	....
Washington C. H.	98%	2%	Front foot	10	Bonds	10
Wilmington	....	....	Front ft., excl. intersections	....	....	....
Oklahoma						
Altus	⅔	....	Front ft., excl. intersections	10	bonds	....
Blackwell	all	....	Front ft., excl. intersections	10	budget	10
Norman	all	....	By 1-4 block	10	budget	10
Wagoner	all	....	Front ft., excl. intersections	10	taxation	....
Oregon						
Ashland	all	....	Front ft., excl. intersections	10	bonds	10
Bend	all	....	Zone system	20	....	10
Dallas	all	....	Front ft., excl. intersections	10	budget	10
Pennsylvania						
Altoona	all	....	Front ft., excl. intersections	10	budget	....
Athens	⅔	⅓	Lot front of E	1	both	20
Bangor	....	....	.....	....	both	20
Bellefonte	50%	50%	6 ft. by owners. Rest boro. Front ft. excl. intersections	....	budget	....
Carbondale	all	....	Front ft., excl. intersections	5	bonds	5
Corry	⅔	⅓	Front ft., excl. intersections	5	both	20
East Bangor	....	....	Boro & state	....	bonds	30
Erie	all	....	Front ft., incl. intersections	10	budget	....
Hollidaysburg	⅔	⅓	Front foot	12	budget	10-15
Jersey Shore	⅔	....	.....	within year	tax	20-30
Meadville	all	....	Front ft., excl. intersections	10	bonds	15-30
Midland	⅔	⅓	Front ft., incl. intersections	within 6 mos.	bonds	3-5, 10-20
Northampton	....	....	General funds	....	both	20-30
Philadelphia	all	....	Front ft., excl. intersections. Repaving not assessed	....	bonds	15-30
Sayre	⅔	⅓	Front foot.	1	both	20
Sharon	all	....	Front ft., excl. intersections	8	both	5
Woodlawn	⅔	⅓	Front foot	....	bonds	10-30
Rhode Island						
Bristol	⅔	....	Rd. surface by town	....	both	20
Cranston	....	all	.....	....	budget	....
South Carolina						
Union	....	all	.....	....	budget	up to 40
South Dakota						
Rapid City	all	....	Front foot	10	budget	....
Tennessee						
Greeneville	⅔	⅓	Front. ft., excl. grad. & drain	10	bonds	10
Harriman	⅔	⅓	Front foot	5	bonds	1-20
Texas						
Childress	¼	....	Front ft. curbs & walks assessed against property	3	bonds	10-40
Cleburne	all	....	Front ft., incl. intersections	....	....	....
Greenville	⅔	⅓	Front ft., excl. intersections	5	bonds	20 yr. serial
Houston	all	....	Front ft., excl. intersections & dr.	5	bonds & gen fd	25 yr. serial
Lufkin	⅔	⅓	Front ft., excl. intersections	....	bonds	30
Navasota	⅔	⅓	Front ft., excl. intersections	....	bonds	20
Port Arthur	⅔	⅓	Front foot	4	bonds	40
San Angelo	....	....	Front ft., excl. excavations	4	bonds	30
Utah						
Ogden	....	....	Front foot	10	bonds	10
Washington						
Olympia	all	....	Area acc. to zones	10	....	....
Port Angeles	all	....	Area of lot ¼ intersections over ¼ block	10	....	10
Walla Walla	all	....	Zone system	10	....	10
West Virginia						
Moundsville	⅔	....	.....	1	....	....
Wisconsin						
Augusta	....	....	Front foot of lot	10	both	3-20
Eau Claire	all	....	.....	5	budget	....
Janesville	....	15-40%	Benefits	5-10	budget	10
Marinette	½	½	Front foot	5	budget	....
So. Milwaukee	all	....	Front ft., excl. intersections	5	budget	20
West Allis	all	....	Front ft., excl. intersections	10	bonds	10-20
Wyoming						
Laramie	....	all	.....	....	budget	....

Recent Legal Decisions

MATERIAL MAN NOT DEPRIVED OF LIEN BY DIVERSION OF MATERIAL BY CONTRACTORS

The question has for the first time come before the New York Court of Appeals whether a material man who in good faith furnishes materials to be used in the completion of a contract for public works within the scope of the State Mechanics' Lien Law loses his right to a lien therefor because the contractor without his knowledge or consent has diverted the materials to some other purpose and has not in fact used them in the construction of the improvement as contemplated. The plaintiff in the case had delivered several lots of cement to the contractor for construction of a road who sold them to other parties, afterwards making an assignment to a bank. The court holds, Giant Portland Cement Co. v. State, 232 N. Y. 395, 134 N. E. 322, that in such circumstances the materialman should not be deprived of his lien under section 5 of the statute, which gives a lien to "a person . . . furnishing materials to a contractor . . . for the construction of a public improvement." He has "furnished" his materials when he has delivered them to the contractor in good faith for the purpose of being used in the improvement. The court says: "It is true that this construction of the act may at times result in injury to other lienors whose liens are subordinated to those of materialmen for materials furnished for, but not actually used in the construction of an improvement. But in our judgment, having in mind that interpretation of the statute which will be for the benefit of materialmen as a class, this possible disadvantage will be small compared with the expense and dangers which would follow an interpretation that a materialman, who had honestly furnished materials for the construction of an improvement, could only have a lien on proof that his material had actually gone into the improvement." The court pointed out that such an interpretation would be disadvantageous to contractors, because, if the lien right of the materialmen was impaired by the possibilities of diversion of the material, materialmen inevitably would be much less willing to trust contractors and enable them to complete contracts.

The court found support for its interpretation of the statute in the following decisions of courts of other states having statutes similar to that of New York: Burns v. Lowell, 68 Minn. 425; Frudden Lumber Co. v. Kinnan, 117 Iowa 93; Breckel v. Petticrew, 6 Ohio St. 251; Hercules Powder Co. v. Knoxville. L. F. & J. R. Co., 113 Tenn. 382; Bell v. Mecum, 75 N. J. L. 547; Salzer Lumber Co. v. Lindenmeier, 54 Colo. 491; Maryland Brick Co. v. Spilman, 76 Md. 337; White v. Miller, 18 Pa. St. 52; Kalbfleisch v. Harley, 34 Ont. L. R. 268.

BROKEN OVERARCHING LIMB OF A TREE NOT A STATUTORY DEFECT IN THE STREET

The Supreme Judicial Court of Massachusetts holds, Andresen v. Town of Lexington, 134 N. E. 397, that a limb of a tree growing on private property, which arched over a sidewalk and fell upon the street after being severed by the wind and sustained for a time by telegraph wires, injuring a pedestrian, was not a defect in the way within a statute imposing liability on the municipality because of death from a defect or want of repair of any way.

VERBAL AGREEMENT BY MUNICIPAL OFFICER TO PAY FOR EXTRA WORK VOID UNDER EXPRESS PROHIBITION OF CITY CHARTER

The Tennessee Supreme Court holds, J. A. Kreis & Co. v. City of Knoxville, 237 S. W. 55, that a verbal assurance by a city's commissioner of waterworks to the contractor for the construction of a pump pit for the city that the contractor would be paid for extra work in enlarging the pit, the necessity for which became apparent during its construction, was unenforceable, the city charter providing that "no contractor shall be allowed anything for extra work caused by an alteration or modification, unless an order is made or an agreement signed by the contractor and approved by the board of public works. The court said that such provisions in a city's charter "have the effect of protecting the city's interest, and tend to prevent extravagant and unwarranted expenditures of the city's funds, and they cannot be disregarded." The fact that the board subsequently agreed to compromise the claim was held insufficient to give it validity.

PREPARATION OF PLANS FOR PROPOSED MUNICIPAL LIGHTING SYSTEM

The New Jersey Supreme Court holds, Franklin v. Horton, 116 Atl. 176, that an ordinance of the city of Millville employing an electrical engineer to prepare plans and specifications for an electric light distributing system for public lighting and for compensation for such services is valid without the necessity of adopting an ordinance for the construction of a municipal lighting plant, since the governing body of the city may, under the New Jersey statute of 1917, cause such a distributing system to be constructed either by the city or by a contractor agreeing to furnish the street lighting. The preparation of the plans and specifications is not work or the furnishing of materials, supplies or labor requiring advertisement for bids.

GENERAL CONTRACTOR HELD NOT LIABLE TO SUB-CONTRACTOR'S EMPLOYEES WHO HAD EMPLOYED SUB-CONTRACTOR TO COLLECT MONEY DUE THEM

In an action against the general contractor for hauling gravel in the construction of a road, it appeared that the plaintiffs were employed by a subcontractor, performed the work for him and subsequently constituted him, although their employer, their agent to collect and pay the money over to them. He collected the money, but failed to pay them. The Arkansas Supreme Court holds, C. A. Keese & Co. v. Kirk, 237 S. W. 680, that the subcontractor was liable to the plaintiffs, but the general contractor was not. It was not incumbent on the latter to see that the subcontractor, as the plaintiffs' agent, paid over to them the money they authorized him to collect.

NEWS OF THE SOCIETIES

CALENDAR

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 5-7—NATIONAL CONFERENCE ON CITY PLANNING. Annual conference. Springfield, Mass. Secretary, F. Shurtleff, 60 State St., Boston, Mass.

June 6-8 — CONFERENCE OF NEW YORK STATE MAYORS AND OTHER CITY OFFICIALS. Annual meeting. Poughkeepsie, N. Y. Secretary, W. P. Capes, 25 Washington Ave., Albany, N. Y.

June 7 — NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Idaho.

June 12—AMERICAN FEDERATION OF LABOR. Cincinnati, Ohio.

June 12-15 — CANADIAN GOOD ROADS ASSOCIATION. Ninth annual meeting. Empress Hotel, Victoria, B. C. (Change of date.)

June 13—ENGINEERING SOCIETY OF AKRON. Akron, Ohio.

June 16-17—ENGINEERING INSTITUTE OF CANADA, Provincial meeting. Vancouver Hotel, Vancouver, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention. Crookston, Minn.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 15-18 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28 — SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The fifty-second annual convention will be held at Portsmouth, N. H., June 21st-22d. The headquarters of the society, secretary's office, etc., will be at the Hotel Wentworth, a shore resort, opened exclusively for the convention. The hotel is operated on the American plan, at rates varying from $7 to $9 per day.

Program, June 19th and 20th—Excursions around Boston, Worcester, and Clinton, Mass. Persons who wish to see historical and engineering points of interest around Boston should call at the rooms of the Boston Society of Civil Engineers, 715 Tremont Temple (88 Tremont street), at whatever time may be most convenient and arrangements will be made for transportation and guides. Such trips will be made in small parties so as to conform to individual desires. Members wishing to see some particular work or place will find it of advantage to communicate in advance with the chairman of the Local Committee.

A special arrangement will be made for those particularly interested in water supply and sewage disposal to vist the municipal sewage disposal plant, Worcester, Mass., and Boston water supply, Clinton, Mass. Communicate with Mr. Harrison P. Eddy, 14 Beacon street, Boston, Mass.

Golf tournament at the links located near the Hotel Wentworth, with suitable prizes.

June 21st—Addresses by Governor Brown of New Hampshire and President Freeman, followed by a business meeting. Papers will be presented by L. C. Wason, "Tests of Concrete in Sea Water"; W. G. Atwood, "Marine Borers" W. K. Hatt, "Progress in and Importance of Highway Research"; Edward B. Wardle, "The Wood Pulp Industry"; Harry W. Clark, "Wastes from a Wood Pulp Mill Chemically Considered"; George C. Whipple, "Pollution of Streams by Paper Mill Wastes"; Mr. O. Lefebvre, "Problems in Connection with the St. Maurice River Regulation"; James H. Brace, "The Gouin Dam on the St. Maurice River."

2 p. m.—Boat trip to Isle of Shoals, weather permitting, or continuation of the technical program.

8 p. m.—A paper will be presented by Frank W. Hodgdon, "Shore Protection and Harbor Development Work on the New England Coast," with discussion led by Henry S. Adams, Frederic H. Fay, Charles R. Gow, and W. Willing, followed by a paper by J. W. Rollins, "Difficult Foundation Problems for Piscataqua Bridge at Portsmouth."

For the ladies—A bridge tournament with suitable prize.

June 22d—Excursion Trip to Casco Bay. 9 p. m., informal reception and dance.

June 23d and 24th—Trip to White Mountains. Arrangements will also be made for excursions around Boston for those who do not wish to go to the White Mountains.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

At the annual business meeting of the American Institute of Electrical Engineers, held in New York, May 19, the following officers were elected:

President, F. B. Jewett, New York; vice-presidents, G. Faccioli, Pittsfield, Mass.; W. I. Slichter, New York; R. F. Schuchardt, Chicago; H. W. Eales, St. Louis (re-elected); H. T. Plumb, Salt Lake City, Utah; managers, H. M. Hobart, Schenectady, N. Y.; Ernest Lunn, Chicago; G. L. Knight, Brooklyn, N. Y.; treasurer, George A. Hamilton, Elizabeth, N. J. (re-elected). At the meeting of the Board of Directors held on the same date, F. L. Hutchinson was re-elected secretary of the Institute for the coming administrative year.

AMERICAN ROAD BUILDERS' ASSOCIATION

The meeting of the Association held May 15th adjourned to meet again at the Automobile Club of America, 247 West 54th street, New York, N. Y., on June 15th, at 3 p. m. (daylight saving time).

PERSONALS

Merrill, Leland G., City Engineer of Parkersburg, West Va., has resigned to accept a position with the West Virginia State Highway Commission and will be located in Division No. 3.

Erwin, M. C., sanitary engineer of the state bureau of sanitary engineering, has resigned to become city engineer and sanitarian of Port Arthur, Tex.

Robert Whitten has opened offices at 4614 Prospect Avenue, Cleveland, Ohio, for professional practice in general city planning and city zoning. He will be associated with A. D. Taylor, landscape architect and town planner, with a thoroughly equipped technical and engineering organization.

Mr. Whitten is at present retained as general city planning consultant by the official city plan commissions of Atlanta, Georgia and Indianapolis, Indiana. He is a member of the Board of Governors of the American Institute of City Planning and of the National Conference on City Planning.

Charron, Henry S., has been appointed superintendent of the water department of Burlington, Vt., to succeed J. Frank Kidder.

Thompson, V. A., city manager, and L. B. Hitchcock, city engineer, of Phoenix, Ariz., have both resigned their positions, due, it is believed, to dissatisfaction with political interference.

Smith, J. Waldo, for many years chief engineer of the Board of Water Supply, City of New York, has resigned, and Thaddeus Merriman, deputy chief engineer of the Board of Water Supply, has been appointed to succeed him.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HOTSTUF PITCH AND ASPHALT KETTLE

This kettle, manufactured by the Aeroil Burner Company, Inc., is intended especially for use with the Aeroil burner and is provided with a melting shelf on which the broken pitch or asphalt begins to melt two minutes after the burner is started. The melted material runs into a separate reservoir where it is maintained at the proper temperature by the escaping waste gases and from which it is drawn off into a pail as required. Pitch is melted at the rate of 50 pounds in four minutes at an average fuel cost of eighty cents per ton of pitch melted.

AEROIL BURNER COMPANY'S HOT STUFF PITCH AND ASPHALT KETTLE

The kettle is 50 inches long, 36 inches wide and weighs 375 pounds and has a capacity of 100 gallons. It is portable, strong, durable, efficient, easy to handle and to clean, and eleminates smoke, fire danger, coking, splashing and waiting for hotstuff. It saves the money usually spent for extra kettle bottoms, will do the work of two ordinary kettles, and can be furnished mounted either on lead or on wheels.

REVOLVING SEWAGE SCREENS

The sewage screens now being installed by the Sanitary District of Indianapolis, for the new sewage disposal plant are of the improved inward flow cylindrical type with axial discharge that prevents the entrance of the sludge and leaves it accessible in the pit whence it is easily removed while the clarified effluent escapes continuously at the end of the cylinder and the screen can be easily cleaned from the exterior.

The screens, of which there are 13, are set in individual wells containing sewage laden water to a depth of approximately 2 feet. As they revolve, the liquid passes through the screen cloth to the interior of the drum and is discharged through the drum head to a trough leading to the settling tank. Meanwhile the solids are removed from the tank by means of scraper conveyors.

The screens, manufactured by the Chain Belt Company, are each 6 feet in diameter and 7½ feet long. They are made almost entirely from bronze to prevent corrosion. The framework is similar to a squirrel-wheel and around it are wrapped two courses of screening, the inner one having a very open mesh, while the outer one is fine enough to prevent practically any of the solids from entering the drum.

The screens are mounted on through shafts in bronze bearings and are driven by Rex Chabelco steel roller chains operating over Temperim sprockets.

DESCHANEL CABLEWAYS

Cableways manufactured by the Deschanel Engineering Corp. are designed for unloading materials directly from railroad cars and barges to ground storage, other secondary storage or to bunkers and coal bins, as well as for reclaiming materials or for removing ashes from boiler rooms and loading railroad cars, trucks, and for depositing materials in ground or overhead storage, all operations being performed with the same equipment without any change.

When headroom is low, the cableways of a two-traction rope type are operated with intermediary A-frames, carrying the traction ropes on saddles. When height is unlimited the single traction rope type is used with towers, the tail tower being moveable if requisite to cover a larger storage and reclaiming area.

The cableways are operated by a two-drum reversible hoist controlled by only two levers for all operations of closing, lifting, conveying and dumping the clamshell bucket, thus eliminating complicated mechanism and foot brakes and permitting the hoisting unit to be located on ground while the operator can be stationed at any height to command a clear view of the entire length of the cableway and all operating power is

FRAMEWORK OF CHAIN BELT COMPANY'S SCREEN COVERED WITH OPEN MESH

CHAIN BELT COMPANY'S SEWAGE SCREEN COMPLETE WITH SPROCKET CHAIN DRIVE

furnished by a continuous electric motor or by a gasoline engine as desired. The cableway is equipped with the Deschanel cableway bucket of the completely automatic bridge type, clamshell design of high efficiency for unloading and reclaiming material.

The cableway traction carriage frame is of rigid construction with positive alignment and has large trolley wheels and sheaves with chilled rims fitted with high duty Hart roller bearings that insure smooth wear-resisting running.

The manufacturers also provide skip hoists for unloading from cars to ground storage or overhead, monorail hoists for the same purpose furnished with traveling cab or pull chain operated from the ground; and a full line of belt, flight and spiral conveyors.

STEEL PAVING GUARDS

Guards for protecting the longitudinal edges of brick, stone, asphalt, or concrete pavements are manufactured by the W. S. Godwin Company, Inc. By their use it is claimed that street railway paving is protected against the wave motion of the rails, against lateral rail movement, that seepage below the surface and contact between the pavement and the car wheel are prevented, and that a rigid lateral support and sufficient strength above the cross-ties are provided.

The guards are made from square or oblique-angle sections with the lower end sheared and bent so as to provide integral anchorages projecting into the concrete pavement or foundation. It is claimed to be the only proven protective agent that permits of rigid paving construction and elastic track construction adjacent to each other.

The installation of steel paving guards permits the satisfactory use of broken stone or natural soil under the ties, thus effecting a large saving of concrete. It also allows the safe use of sheet asphalt or other bituminous surface over the entire railway area. The manufacturers estimate that its use in place of block

PRECAST CONCRETE RAILWAY CROSSING PROTECTED BY GODWIN COMPANY STEEL GUARDS

liners nets a saving in cost of from four to forty-three cents for liners 8 to 20 inches wide for single width and a saving of repairs of forty-four cents. The liners are equally suited for grooved or tee rails and are suitable for pre-cast concrete railway track when hard surface pavements are made adjacent to unpaved railway tracks. The use of steel guards to protect the edges of the pavement is claimed to give lower initial cost and greater protection without involving any material cost for removal if the track area is subsequently paved.

SIX-INCH CONCRETE PAVEMENT PROTECTED BY GODWIN STEEL GUARDS

INDUSTRIAL NOTES

Payne Dean, Ltd., 103 Park avenue, New York City, manufacturer of Dean control for electrical operation of water, gas and high pressure steam valves, has established offices in Pittsburgh and Chicago, with C. N. Burrago in charge of the former and A. H. Kohlbusch in charge of the Chicago office.

On May 1st the New York offices of the American-LaFrance Fire Engine Company, Inc., and of S. F. Hayward & Company, their subsidiary, were moved from West 54th street to the new Fisk Building, 57th street.

The Hiram Phillips Engineering Co., St. Louis, Mo., successor to W. R. Heagler & Sons, Paragould, Ark., and Hiram Phillips, St. Louis, will specialize in drainage, flood protection, irigation, sewerage and water supply.

The U. S. Cast Iron Pipe & Foundry Company announces that it has opened a new office at the Interstate Building, Kansas City, Mo., which will be in charge of Mr. D. W. Pratt, sales agent.

The Chicago office of the Elgin Sales Corporation was moved to 10 S. La Salle street on March 31.

The Wayne Tank & Pump Co. is the new name of the former Wayne Oil Tank and Pump Co., which has enlarged its business and will manufacture water softening machinery and other water handling apparatus. The address remains the same—Fort Wayne, Ind.

The Frazier-Ellms-Sheal Co., Illuminating Building, Cleveland, Ohio, announce the association of Mr. J. T. Martin, former Water Commissioner of Cleveland, as an active member of the company in the capacity of vice-president and treasurer for the conduct of their general engineering business.

Mr. Martin has been actively engaged for over 20 years in water works projects, covering construction of tunnels, reservoirs, distribution system, filtration and power plants, water works accounting and administration.

The Orton & Steinbrenner Co. of Chicago and Huntington, manufacturers of locomotive cranes, clamshell and orange peel buckets and coal crushers, have made arrangements with J. Ross Bates, formerly connected with Wonham Bates & Goode Trading Corp. of New York and Boston, to represent them in the New England States and New York City.

Mr. Bates has offices at 136 Liberty Street, New York City, and 128 School Street, Watertown, Mass.

The Hammond-Byrd Iron Co., of Birmingham, Ala., with operating offices in Chicago, San Francisco and New York, will re-enter the field to sell and distribute cast iron water main, gas main and fittings.

The Kennedy Valve Mfg. Co. has announced the following changes in its organization—the appointment of H. D. Kane as assistant to C. A. Burgess as traveling representative with headquarters at Elmira, N. Y.; of James P. Murphy as assistant to S. C. Mead, Chicago branch manager; and of John J. Milliken as assistant to E. H. Koone, eastern sales manager. Also, an additional office has been opened in the L. C. Smith Bldg., Seattle, Wash.

GODWIN COMPANY'S GUARDS PROTECTING THREE-INCH ASPHALT PAVEMENT ADJACENT TO GROOVED RAIL

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 June 10, 1922 No. 23

Piers and Abutments of the Springfield Bridge

Construction of solid and hollow concrete substructure in sheet pile cofferdams. Storage and mixing of aggregate, distribution of concrete, and installation of contractor's plant for handling 54,000 yards of concrete and 110,000 yards of dredging.

The concrete arch bridge across the Connecticut river and the N.Y., N. H. & H. R. R., connecting Springfield and West Springfield, is 1,494 feet long over all, 80 feet wide and 56 feet high and includes seven arch spans varying from 176 to 110 feet long. It is being built by the County Commissioners of Hampden County for highway and streetcar traffic at a total cost of about four million dollars. Fay, Spofford & Thorndike are the designing engineers, and H. P. Converse & Co. is the principal contractor.

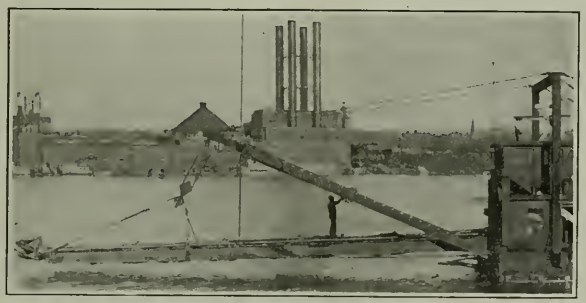
The superstructure consists of seven five-rib two-hinge parabolic one-arch river spans of reinforced concrete, and a viaduct with nine reinforced concrete floor slab spans over the adjacent railroad yard, as described in PUBLIC WORKS for May 20-27.

The substructure for the river section, which is 1,182 feet long, is of granite-faced concrete with wooden pile foundations built in wooden sheet pile cofferdams, constructed in pits dredged to a maximum depth of 25 feet below mean low water in the sand and gravel of the river bed.

The bridge was authorized by the legislature in 1915, but the final plans were not completed by the Special Bridge Commission until 1919. Active work on construction was commenced in April, 1920; about 90 per cent. had been completed February 1st, 1922, and it is expected that the bridge will be opened for traffic about the first of August next.

SPECIAL FLOATING EQUIPMENT

Supply scows, barges, derricks, lighters and other plants of suitable size could not be brought up the river because of the small size of the locks at Windsor, hence eight 18x75x7-foot scows or lighters containing 280,000 feet of Oregon fir were built at an improvised shipyard and launched. These were used singly for transporting materials from the Hampden Park yard to the bridge site, and two of them fastened together formed a lighter.



DREDGE FOR PIER EXCAVATING.

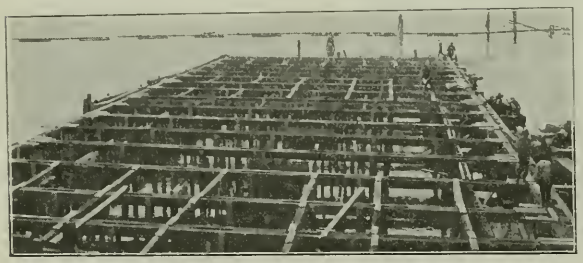
Gasoline towboats and lighters were brought by the contractor from a previous job at Norfolk, the lighters being so large that they were cut in two longitudinally, and sometimes transversely, passed

LAUNCHING SCOW NEAR BRIDGE SITE.

through the locks at Windsor, and finally bolted together again at the site.

By removing the side pontoons, cutting arms and other portions of a suction dredge, which had been designed for use on the Erie Canal, the hull with mechanical equipment was able to pass through the locks. Much of the smaller equipment, such as derricks, machinery, cars and tools was delivered to the site by rail.

In the contractor's principal yard at the West Springfield end of the bridge there is installed a complete construction plant, including concrete mixer, cement and aggregate storage, an elevated material trestle, sheds, shops, derricks and service tracks.



COFFERDAM BRACED FOR UNWATERING.

A large material yard has been established at Hampden Park on ground reached by the Boston & Maine railroad, from which a spur track was laid for the transportation of plant and materials. Provision is made for receiving, sorting and storing there granite, structural steel, reinforcing steel and other bulky materials delivered by rail, where they may be transferred by a locomotive crane at a wharf on the river bank to scows which are towed about ½-mile down the river to the bridge site. This yard has also been used for casting 389 concrete piles for the viaduct foundations, as well as for the storage of 4,700 yards of cut granite, 3,500 tons of steel, 300,000 paving blocks, 3,000 linear feet of curb and 89,640 feet of conduits.

EXCAVATION

Excavation at the pier and abutment sites and the elimination of shoal places in the waterway required the removal of 110,000 cubic yards of sand and gravel that was pumped by a 12-inch suction dredge, provided with a revolving cutter head, at the rate of about 40 yards per hour, and delivered through a maximum of 2,000 feet of flexible-joint pipe. 12 inches in diameter, which was floated on pontoons, and discharged over the West Springfield meadows, where there was thus deposited a fill of 12 feet in maximum depth over an area of 4.2 acres, thus reclaiming valuable land. Besides dredging the areas of the pier footings, a zone across the river 250 feet upstream and 150 feet downstream from the center line of the bridge was dredged to a depth of 13 1/2 feet below low water, insuring the required waterway between the piers.

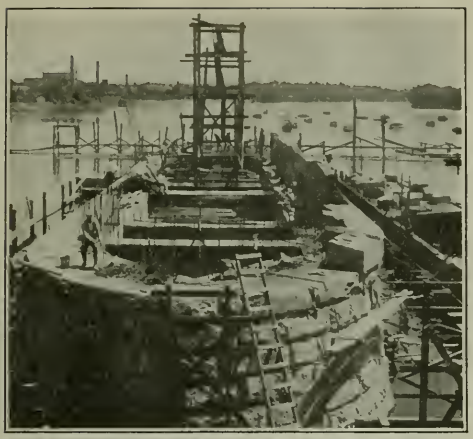
PILE DRIVING

After the pier and abutment sites had been dredged to depths of 14 to 25 feet below mean low water level, two floating pile drivers equipped with Vulcan No. 2 steam hammers commenced the driving of the 10,500 foundation piles placed about 2 feet apart in groups varying from 700 at pier 1, to 2,263 at each of the channel piers, 4 and 5. The piles were of pine shipped from Delaware and Maryland and were from 20 to 40 feet long. They were driven with a follower operated in extension guides and had full penetration with the tops projecting from 6 to 18 inches above the bottom of the dregded area. The tops of the piles were driven to within one or two inches of the required elevation and the ends being uninjured by the follower, were not cut off after driving. The maximum number of piles driven by one hammer in a single 8-hour day was 110, and the average number driven per day by both hammers was 110.

COFFERDAMS

After the piles had been driven for each foundation, the group was enclosed by a cofferdam of 6-inch grooved and splined Douglas fir sheet piles, 36 to 38 feet long, shipped from the State of Washington. They were driven to a penetration of 22 feet at the rate of about 25 pieces per 8-hour day by a drop hammer. After the construction of the

BUILDING PIER FORM IN COFFERDAM.



CONCRETING UPPER PART OF HOLLOW PIER

piers, the cofferdams were removed and the sheet piles were pulled at an average rate of about 91 pieces per day by a floating derrick with a six-part tackle operated by a hoisting machine.

Gravel filling 6 inches thick was deposited around the pile tops in the bottom of the excavation and on it concrete was placed under water with bottom-dump buckets that retained it until the buckets touched bottom, thus preventing the cement from being washed out or the aggregate segregated by the action of the water. In this manner the footing was built up to elevation about 6 feet below low water level, sealing the cofferdam and practically completing the footing.

The interior of the cofferdam was braced by a system of intersecting longitudinal and transverse struts bearing against the sheet pile walings at about low water level, and forming rectangular pockets about 8 feet by 12 feet. The cofferdam was then unwatered by centrifugal pumps, one 6-inch pump sufficing to hold the water after unwatering.

The granite facing was laid up like ordinary ashlar masonry, one course in advance of the concreting, and served as a form to hold the latter in position. In the case of the hollow piers the concrete was placed around interior wooden forms acting as cores, which were accessible through manholes in the tops of the piers and were removed after the concrete had set.

The principal quantities involved in the construction of the six river piers included 108,600 yards of dredging, 7,980 wooden piles, 25,555 yards of concrete, 4,078 yards of granite, 15,440 tons of riprap and 2,091 linear feet of sheeting.

The skewback stones, of which there are 70 to receive the inclined bases of the pedestals for the arch ribs, are massive granite blocks built into the coping course and backed up with the solid mass of concrete. The faces of these blocks were dressed to exact planes after they had been set, in an average time of about 80 hours for each stone. All of the granite was quarried at Cape Ann near Gloucester, where the stones were cut and numbered, then shipped by rail to the Hampden Park storage yard and delivered to the site by lighters, as needed.

The operations for the construction of the abutments were similar to those for the piers and were carried on in wooden sheet-pile cofferdams, which, however, were not pulled. The voids left in the east abutment were filled with gravel and the foundations of both abutments and of all the piers were protected by riprap stones up to ten cubic feet in volume.

The cofferdam method of constructing the piers was selected by the contractor in preference to the floating caisson method, which was a permissible alternative and provided that the permanent concrete base of the floating caisson should rest on 4-inch soft wood planks that were expected to yield to the heavy pressure and adapt themselves to the irregular surfaces of the pile tops under the weight of the pier.

The principal quantities involved in the abutments were 885 linear feet of cofferdam, 9,580 yards of excavation and backfill, 8,315 yards of concrete, 622 yards of granite, 2,531 wooden foundation piles and 1,080 tons of riprap. The viaduct foundations consist of concrete piles supporting concrete bases for the piers and required 8,772 yards of excavation and backfill, 1,493 yards of concrete and 389 concrete piles. The West Springfield approach required 283 yards of excavation, about 140,000 yards of embankment, and 571 yards of concrete. The viaduct superstructure required 3,135 yards of concrete and 140.6 tons of structural steel.

Refuse Collection in New Orleans

Tractor and Trailer System Collects Refuse and Transports It Six or Eight Miles to Dump, Where It is Burned—Incinerator to Be Put in Service Soon

In New Orleans it has been customary for many years, when a leader in ward politics died, for his friends to provide by contribution, a dump cart and a mule which was turned over to the widow and hired by the city for the collection of garbage. The city had on its payrolls up to a year ago, about 150 of these carts, for which it paid $4.50 per day, which included the services of the driver.

This, known as the "widow's cart system," is being displaced by a new one, which has been in operation in about one-half of the city for about five months and which it is proposed to extend to the entire city. This is the tractor-trailer system, the equipment being owned by the city and operated by city employes.

In the new system, the collection unit is a straight-frame trailer with removable steel container of two cubic yards capacity, which is drawn by mules for house-to-house collection. When they have been filled, the trailers are hauled to designated points, where they are picked up by a truck or tractor and taken to the dump some six to eight miles distant. Here the steel container is removed by a locomotive crane and its contents spread on burning fires. This depositing on burning fires, which makes necessary

the use of steel containers handled by a crane, is for the purpose of complying with a regulation of the U. S. Public Health Service, which is conducting a campaign for bubonic plague eradication and insists that garbage and refuse shall be so treated to prevent the propagation of rats.

Disposal at these dumps involves operating two cranes, which, with the miscellaneous labor, costs about 50 cents per ton of refuse handled.

The dumping ground is a low, swampy area beyond the city proper. Previous to the inauguration of the tractor-trailer system, low areas within the built-up part of the city were used as dumping places, and were within economical hauling distance for carts and mules. But the tolerant attitude of the public to these unsanitary dumps has been giving place to indignant demands that the nuisance be removed beyond the city limits; although several of these dumps to which the objection is not so pronounced continue to be used.

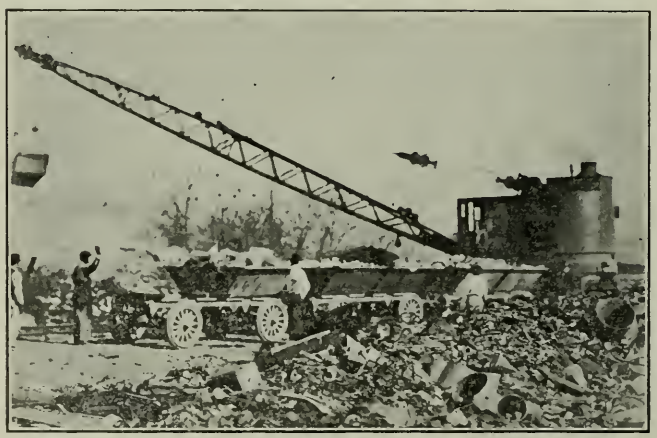
The new collection system is found to be a big improvement, in point of service to the public, over the old mule and cart and nigger driver, but there still remain some kinks to be straightened out, particularly loss of time due to imperfect synchronizing of the collection times of the several collecting units. Collections are made daily, winter and summer. The householder is not required to separate refuse or "trash" from garbage.

The method of disposal now employed is considered to be only a temporary one pending the erection of five incinerators that the city proposes to build. Contract has been let for one of these and money is available for two more. These three are to have a capacity of destroying 100 tons each of mixed garbage and refuse in 16 hours. The other two are planned to have capacities of 60 and 40 tons respectively. It is guaranteed that the incinerator will operate at a cost of 54 cents per ton for labor, exclusive of the cost of handling ashes, and that no commercial pull will be necessary if the rubbish content is not less than 30 per cent by weight of the material burned, which is about the proportion for New Orleans refuse.

The removal steel containers used on the trailers will adapt themselves to the contemplated incinerator operations, as they will permit storage of garbage within the incinerator building in a sanitary way.

Disposal by incineration seems to meet popular approval as well as being the conclusion reached by a committee of engineers who visited many cities in the East and North and who, taking everything into consideration, decided that disposal by incineration was the best solution of New Orlean's problem.

For the above information we are indebted to John Klorer, city engineer. The work is under the charge of the Department of Public Property, Engineering Division, Wilbert Black, commissoner.



GARBAGE BEING DUMPED ON BURNING AREA
Refuse already burned is shown in foreground

Sand Hog Work Less Dangerous

The work of the "sand hog," or laborer who excavates in compressed air as in sub-aqueous tunnels, is reported by the U. S. Bureau of Mines to be less dangerous than it was a few years ago. Observations made by Dr. Edward Levy, consulting physiologist of the bureau, during the progress of tunnel work in and about New York City, indicate that the methods employed there are so improved as almost to eliminate severe cases of compressed air illness.

Knowledge of the cause, character and treatment of compressed air illness is still limited to a very few physicians. The cause is a too rapid decompression after exposure to high pressures, and the symptoms are vertigo, difficult breathing, localized pains, affections of the central nervous system and unconsciousness or collapse. The formation of gas bubbles of nitrogen in the body fluids and tissues is the accepted theory at present of the cause of caisson disease. Men should be selected for such work that have normal lungs and kidneys and a good heart, and in the older men the blood pressure must not be high. The bureau questions whether older and fleshier men are especially susceptible to this illness.

A worker suffering from compressed air illness should be put in a medical lock and the pressure rapidly raised to that in which he had previously worked. It is well to keep him at this pressure for a short time to insure that the bubbles of nitrogen have been thoroughly compressed and again taken up by the circulation. The patient may then be decompressed again by the stage method, except that now the time should be double in every part of the decompression Although symptoms are frequently relieved before the pressure in which the man had worked is reached, it is safer to attain the original pressure before decompression.

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Progress Report on Illinois Road Tests

The report on the second traffic run tests of the Bates Experimental Road, which was constructed last year by the Illinois Division of Highways for the purpose of making such tests, is to be considered as a progress report, and the conclusion, as in the case of all tests, should be interpreted with due consideration to the conditions under which the tests were made and the duration or number of such tests.

As stated a few weeks ago by the state highway engineer, the subgrade was not well drained, it being a question whether good drainage is practicable in the locality where the test road is located. This means inadequate support by the sub-base and excessive beam stresses in the roadway slabs.

One unexpected feature is the indication given by the night tests that the edge of the pavement is no more liable to break after the top has cooled off and contracted, causing the edge to rise off the subgrade, than it is during the heat of the day. For this the explanation is suggested that, even in the daytime, the edges of the slab may not rest on the subgrade because the latter has been depressed by the traffic that has already passed. This point, as well as others, will probably be investigated by further tests.

Refuse Dumps

Whatever its legal right, has a city a moral right to maintain a nuisance anywhere within its limits—or outside them? Most refuse dumps, as they are operated, are nuisances, and probably the majority of communities maintain or permit them until protests become so insistent that they are one by one discontinued—often by starting new ones further out. An instance is noted in an article in this issue, wherein it is stated that New Orleans is operating a dump several miles outside the city, most of those inside the city having been abandoned as a result of indignant protests.

The excuse is often made that the dump "must be placed somewhere," and the site chosen is generally in the section of low-value property, where the poorer classes live. A proper regard for these would treat them with even more consideration than the wealthier citizens with a view to improving them physically, morally and esthetically rather than further degrading them. With such a municipal institution as a dump at their doors instead of a park, with this offered to the children of the neighborhood as a playground, what chance have the uplifting agencies of the community in their efforts to improve the home life of these classes and their respect for the municipal government?

Even if the dump be placed in some section at present removed from all residences, houses of the poor soon spring up around it in most cases, not because they desire to be near the dump, but because it so depreciates the value of surrounding property that they can find cheaper homes here than elsewhere, and living cheaply is the most important consideration of their lives.

It is true that the refuse must be placed somewhere. It is also true that the city has no right to either depreciate the value of any property or degrade any of its citizens. If areas can be found already uninhabitable and useless for any other purpose, such as swamps, and sufficiently distant from inhabited areas, this offers a favorable solution unless the cost of haul to it is greater than that of sanitary disposal nearer the center of the collection area. Or a dump may be maintained in the center of a piece of land outside the city and of such size that surrounding owners cannot reasonably object.

But we believe that a dump can be maintained that will not be a nuisance.

Such a dump should not spread ashes and papers around the neighborhood:—surround it by a fence and this in turn by trees and shrubbery, which will effect this end and also conceal the dump from view. If necessary, sprinkle the ashes to prevent dust.

It should not emit odors:—Limit the amount of putrescible matter deposited there and have the caretaker spread it in thin layers and immediately cover it with ashes or soil. If there is too much garbage or too little ashes to insure this at all times, have the garbage burned with plenty of fuel (to maintain a high temperature that will burn all odorous gases) in a proper incinerator operated by faithful attendants. Prevent fire from starting in the fill itself, where it will smoulder and emit nauseous odors. The surest way to effect this is to burn all inflammable matter in the incinerator.

The wagons should not themselves be a nuisance in traversing the streets approaching the dump:— See that each is provided with a cover and that it is kept over the load at all times except when refuse is being emptied into it, and especially as it approaches the dump. Have garbage wagons with low sides so that pails can be emptied into them without soiling the outside. Have noiseless wagons, which may mean rubber tires and canvas or other non-metallic covers. Have the wagons cleaned daily and kept painted and in general give as much attention to them as to the apparatus of the fire department.

This will cost. But not really so much in money as in forethought and conscientious and eternal vigilance. A better grade of employes must be selected and trained to secure the ends aimed at. All concerned must learn to take a pride in the results and secure results they can take pride in, instead of performing a disagreeable task in any way that will give them the least trouble.

Such a dump can be leveled off and top soil applied, and the screen of fence and shrubbery moved forward from time to time, leaving behind it a gradually increasing area of park, or land that can be sold for building sites if no garbage or other putrescible matter has been placed in the dump. And if all resulting values and the costs be balanced, it seems that this plan as compared with present methods will be found very desirable considering the improved appearance and self respect of the community.

A Notable City Planning Project

What is reported to be the largest single piece of city planning by private enterprise ever undertaken in this country for permanent development is the Palos Verdes project in Los Angeles. This is for the construction of a new suburb similar in some respects to Roland Park, Baltimore, Forest Hills, Long Island and St. Francis' Wood, San Francisco, although much larger than these. It is proposed, however, to provide a greater proportion of low-priced homes and home sites. The ground secured for the purpose contains 16,000 acres facing on about 14 miles of ocean front at the southwest corner of the Los Angeles metropolitan area and opposite Catalina Island.

Preliminary estimates of the expenditure contemplated include $6,000,000 for 125 miles of concrete paved streets, $1,800,000 for sewers, $1,650,000 for the water system, $5,000,000 for the land, $1,300,000 for ornamental plantings, $2,000,000 for hotels and clubs, $2,000,000 for parks, schools and playgrounds, $3,000,000 for three civic centers with business blocks, $1,000,000 for a university, $4,000,000 for transportation, $5,000,000 for a home building fund and $2,250,000 miscellaneous; giving a total of $35,000,000.

The purpose of the home building fund is to finance the building of several thousand houses, arrangement for second mortgage loans being provided in the trust agreement, the title already being held to the land. It is proposed to use part of this sum for the organization of co-partnership housing, similar to that tried in England, in order to furnish working men's homes in quantity on easy terms and with maintenance and upkeep provided. No buildings can be built anywhere on the property unless the plans are approved by the art jury, which will be a permanent body endowed with sufficient funds to do real work.

The staff appointed to develop the project includes Olmstead Bros. of Brookline, Mass.; Charles H. Cheeney as city planner; H. T. Cory as chief of engineering; Hunter Liggett, supply service and Myron Hunt as chairman of the art jury.

Pittsburg Road Tests Renewed

The tests of the Pittsburgh (Cal.) highway, which we described in PUBLIC WORKS a few months ago, were discontinued on January 28th, the trucks having traveled altogether 75,000 miles carrying 3,668,100 tons for each section of the test road. This test was carried on by the Columbia Steel Co. Testing of the road is to be renewed by the California Highway Commission acting jointly with the U. S. Bureau of Public Roads. At the conclusion of these tests the commission and the federal bureau expect to start an entirely new series of tests on the same ground, which has been offered for the purpose by the owners, the Columbia Steel Co.

At the conclusion of the test last January all broken parts and timber patches were removed and the track was rebuilt with new concrete and when the tests were renewed recently the highway was believed to be in practically as good condition as when the tests were originally started last November.

Sheet Asphalt on Asphalt Macadam Base

During 1921 the Department of Public Works of Providence, R. I., constructed 22,584 square yards of sheet asphalt, a large part of which was laid on an asphalt macadam foundation. On those parts of the street between the car tracks and in other areas that would not receive very heavy traffic a 6-inch cement concrete foundation was used; but between the car tracks and the curb and on straight stretches a 6-inch asphalt macadam base was placed to carry the sheet asphalt.

This asphalt macadam base was constructed of 2-inch trap rock thoroughly compacted, to which Texaco asphalt cement was applied by four auto-truck distributors owned by the city, about 1¼ gallons per square yard being used.

Asphalt macadam pavement to the extent of 217,436 square yards was laid on the residential streets of the city.

At the tenth annual convention of the Chamber of Commerce of the United States, recently held in Washington, a resolution was passed requesting investigation by the government to determine what additional measures should be undertaken to safeguard the large area in the country now subject to destructive floods.

The construction of the 30-mile Ridge Route Highway in California cost $1,500,000 and it is conservatively estimated by State authorities that this road effects an actual saving to motor vehicle users of $6,000 daily, so that in the first year the road paid for itself.

The Illinois Road Tests

The second series of tests apparently indicate that slab corners are mutually supporting when the concrete expands; that night loading is no more serious than day loading; and that wider pavements are more durable than narrow ones.

The road constructed by the Illinois Division of Highways for test purposes, known as the "Bates Experimental Road" was described in the February 5th and 19th, 1921 issues of *Public Works*. The second of the traffic run tests on this road was completed on May 13th, when the 63 sections of the road had been subjected to 3,200 applications of the last increment of load.

The load which was applied to the pavements during this run was 3,500 pounds on each rear wheel of the trucks and 2,150 pounds on each of the front wheels. Three-ton Liberty trucks, with bodies attached, were used to produce the load, and brick piled in the body made up any deficit in weight. The loads as applied corresponded to 350 pounds per inch of nominal width of rear tire, and 430 pounds per inch of width of front tire. Though it was originally intended to apply this load only 1,000 times to each edge of the sections, it was later decided to subject the pavements to a greater number of applications in order that the thinner sections might be given a thorough test to determine their resistance qualities.

The load was first applied as in the preceding test, the trucks traveling on the extreme edges of the pavements. After 627 applications had been made in this manner it was decided to move the traffic in on the north side with the outside rear wheels of the trucks traveling 2 feet, 6 inches from the edge. The object of this was to study the results on pavements with the loads applied at a certain distance from the edge, it now being obvious that less damage would be done by a load at this position than at the edge. It seems entirely possible that the material necessary to construct a narrow, rigid slab of sufficient strength to carry given wheel loads, would, if used to construct a thinner slab of greater width, result in a pavement of equal or greater durability. Such a result would be due to the fact that wide roadways would in all probability lessen the frequency of the application of maximum loads to the weak points—the corners. Reasoning along this line, it is quite possible that added load-carrying capacity can be secured more cheaply by adding to the width of the pavement than in any other way.

CORNER SUPPORT BY EXPANSION.

After a total number of 1,167 applications of this load, it was noticed that exceptionally strong support was given the corners of the sections by the adjoining slabs. In other words, the pavement, due to prevailing warm weather, had expanded to such an extent that the loads were distributed across the joints, which contained no dowels, in the same manner as over joints that contain dowels. This condition eliminated to a great extent the free corners or weakest points in the slabs, and resulted in a greater strength of section than is normally the case during the late fall, winter and spring months. To prevent this condition, one transverse cut about one inch wide was made through each section of pavement of rigid type and the cut thus formed was filled with asphalt. The traffic was then started and 1,000 additional applications of the load made.

NIGHT TESTS.

Upon the completion of 2,167 applications of this load, night traffic was started. Preliminary investigations on the Bates Road showed conclusively that during the night the edges of rigid type pavements curl up and while in this position receive very little or no support from the subgrade. Pavements in the localities where night traffic is imposed upon them, especially in the vicinities of large cities, must necessarily withstand this extreme condition of strain and it was with this in mind and to gain an insight to the actions of various types of pavements subjected to this condition, that the night traffic on the Bates Road was introduced.

An electric lighting unit was installed at the test road in order to facilitate the night runs.

As the maximum curling of pavement has been indicated to take place between the hours of 9:00 p. m. and 6:00 a. m., the night traffic was applied during these hours. Fourteen trucks were employed in both the night and day runs with the 3,500-pound load, approximately 350 applications being secured in the day time and 300 at night. Due to an extremely heavy rain storm at midnight on the second night of the run, traffic was temporarily suspended and only 167 applications were secured at that time.

SUMMARY OF TESTS TO DATE.

Thus, up to date, the pavement has been subjected to:

One thousand round trips of the trucks loaded with 2,500 pounds on each rear wheel and 2,150 pounds on the front wheels, day time loads, the outside rear wheel running directly on the edge of the pavement.

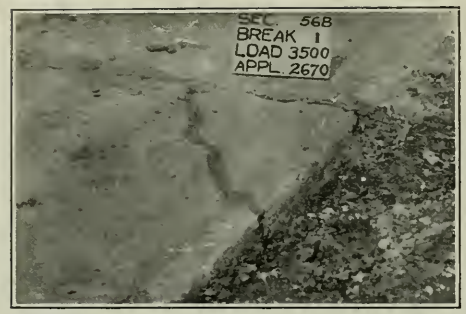
Six hundred and twenty-seven trips with loads of 3,500 pounds on each rear wheel and 2,150 pounds on each front wheel, day time loads, outside rear wheel running directly on the edge of the pavement.

Five hundred and forty day time trips with the same load but with the outside rear wheel running directly on the edge on one side of the pavement and 2 feet, 6 inches in from the edge on the other side.

One thousand day time trips with the same load and with the trucks applying the load along the same line but with the joints of the pavement cut open.

One thousand thirty-three night trips with the loads applied under the same conditions as previously.

Observations of the effects of the traffic were made



PORTLAND CEMENT CONCRETE, ONE CORNER FAILURE, APPARENTLY DECISIVE

in the same manner as in the first run on the road, observers being assigned to a certain number of sections to record all cracks and failures as they occur. Traffic breaks were considered failures.

A 3,500-pound load applied six inches from the corners of the thinnest (four-inch) rigid pavements produces tensile fibre stresses of about 500 pounds per square inch, considering the corners as unsupported cantilevers. As the test specimens cast of the same material and at the same time as the sections were laid had showed a modulos of rupture of from 600 pounds to 650 pounds per square inch, the actual stress produced in these sections is approximately 75 to 80 per cent. of the ultimate, and therefore corner breaks in all such sections might be expected.

This same load applied in like manner to five-inch rigid pavements produced tensil fibre stresses of about 300 pounds per square inch.

After the line of traffic had been changed from the edge to 30 inches in on one side of the pavement, there were no further failures on that side, but on the opposite side—resulting from applications of loads received after the line of traffic was changed on the one side—there were 14 corner breaks in all, 6 occurring before the joints were cut and 8 after the joints were cut. There is no doubt that the change of traffic prevented further failures on that side of the pavement.

That the opening of the cracks and joints, due to cold weather, makes a marked difference in the carrying capacity of a given pavement is shown by the results obtained from this test. Only two corner breaks occurred during the 1,167 applications of the 3,500-pound load before the joints were cut, but 7 corner breaks occurred during the following 1,000 applications of the same load applied after the joints had been opened.

Apparently the night loading was little if any more serious than the day loading, possibly due to the fact that the subgrade had been crowded away from underneath the edge of the pavement before the night runs were made, by the continuous applications of the truck loads along the edges. If this is the condition, the stress during day loading to which the slab was subjected would be as great as during night

COMPLETE FAILURE UNDER FIRST INCREMENT OF 2,500-POUND LOAD

PRACTICALLY COMPLETE AND CONTINUOUS FAILURE ALONG WHEEL TRACKS

loading, which would account for the fact that as a result of the 1,033 applications of the night loads, with joints open, only two additional breaks were observed, while as a result of 1,000 applications of day loads applied just previous and under the same conditions, six breaks occurred.

The next increment of load to be applied will be such that each of the rear wheels will carry 4,500 pounds, and each of the front wheels 2,000 pounds. The load on the front wheels is lessened under this load due to the increased weight in the rear taking some weight off of the front of the truck. One thousand or more applications of this load will be made in the day runs and there is some possibility of running the same number at night, this latter step to be considered after the completion of the day run.

BEHAVIOR OF SECTIONS.

Six of the sections were of bituminous-filled brick on macadam base. Four of these were considered to have totally failed after the passage of about 1,000 loads of the second increment, and two after about 1,500 loads.

Of the six sections of asphaltic concrete on macadam base, one showed no failures, one showed three, two showed six, one failed completely under the first increment of 2,500 pound load, and the sixth failed completely after the passage of 3,200 loads of the second increment of 3,500 pounds, which load is considered in excess of the capacity of this pavement.

Of the twelve sections of asphaltic concrete on Portland cement concrete base, three showed cracks through the curb, which it is thought may not be indicative of decisive failures; eight showed no apparent failures except two curb cracks in one section; and one showed one corner break, probably due to impact from the breaking of an adjacent corner, and a number of curb cracks.

Of thirteen sections of bituminous filled brick on Portland cement concrete base, there were no apparent failures in three; three sections had cracks in curb and base that were not considered decisive failures; two corner cracks that may not be decisive failures; and five sections in which cracks and corner breaks indicated decisive failures.

Of seven sections of brick constructed monolithic and semi-monolithic with Portland cement concrete base, three failed decisively on indicating that the critical load had been reached under the previous test; one with four corner cracks with progressive breaking, and one with a corner failure and two corner cracks. The other three showed surface cracks but not base failures.

Of 27 sections of Portland cement concrete, 21 showed no apparent failures, two developed corner failures that were apparently not decisive, and the other four suffered decisive corner failures.

Engineers' Plans for State Health Boards*

Regulations of the State Boards of Maryland, Massachusetts and Michigan, with respect to the matter and form of plans and reports required to accompany applications for water and sewerage permits

Maryland (Continued) *Sewerage.*—Plans showing all sewers are required; also profiles of each sewer show elevations of sewer and ground and station number at each manhole. "The elevation of sewer invert should be shown by a figure placed immediately below in a horizontal position, and the size and grade of the sewer, together with the character of the material of which the sewer is constructed, should be placed just below the invert line and parallel thereto, unless the sewer is large, in which case the information may be written above the invert line. The scale for profiles must be not greater than 40 ft. nor less than 200 ft. to 1 in. horizontal and between 4 ft. and 10 ft. to 1 in. vertical; preferably 100 ft. and 10 ft. respectively.

Detail plans are required of pumping stations, disposal plants, sections of sewers other than vitrified clay or cast iron, and all appurtenances.

There is also required a "complete report of the engineer. . . containing full information concerning the system and all its features," estimated cost; area to be served, the estimated population and estimated sewage flow, both present and future; with data concerning leakage, manufacturing waste, methods of disposal, description of disposal plant, etc.

Accompanying the instructions are general requirements as to the design itself—separate system generally necessary, minimum size, depth and grade of sewer, location and dimensions of manholes, etc. Vitrified pipe in 3-foot lengths is called for, and double strength above 12-inch.

Massachusetts.—"This department has no general rules or regulations relative to the preparation of plans for sewerage and water supply systems."

Michigan.—The Michigan law does not provide for the submission of plans for sewerage and water works until after the work has been done. Edward D. Rich, state sanitary engineer, says "In cities where high-grade city engineering departments are maintained we have no trouble because the work is carried on in conformity with good practice. We confer with the city engineers of such places on matters of general policy and ordinarily leave the details to their judgment. . . . We feel that our law is seriously defective, but under the circumstances we have done the best we could and have been really surprised that no more serious difficulties have arisen."

With reference to the plans showing completed work, the regulations of the board call for maps on a scale of 300 feet to one inch or larger, a tracing, blueprint or drawing on substantial paper. For sewerage they must show all streets and other physical features, schools and public buildings, and sewers; also areas that cannot be drained by gravity; also outlets, overflows and location of disposal works. Maps requiring sheets more than 24 by 36 inches may be made in two or more sheets. All plans must be submitted in duplicate and signed by the engineer and the authorities having the work in charge. Existing sewers should be shown in solid lines, proposed ones in broken lines; manholes by plain circles and flush tanks by circles filled in, and other appurtenances by appropriate symbols. Sizes and materials of sewers must be plainly marked and the points where the sizes change be clearly indicated.

Instructions as to surface and sewer elevations on the map are as in the Arkansas instructions. Elevations of sewer outlet, overflows, disposal works and high and low water of streams must be given.

Sewer profiles are not required but the department reserves the right to call for them. Details of sewers except standard circular sewers and of all appurtenances of special structures shall accompany the general plans, supplemented by the necessary explanatory notes. Drawings of disposal works must be in sufficient detail to give a clear understanding of the working of each unit, showing distribution

* Continued from page 386.

and drainage systems, automatic devices, sizes of filtering material, etc.

In addition to the map and plans, blanks supplied by the board are to be filled in for either sewerage or water supply. The sewerage blank calls for information concerning population, length of each size of sewer and material it is constructed of, number of manholes, flush tanks and other appurtenances, with the average distance manholes in sewers up to 24 inches in diameter and also in sewers over 24 inches; also descriptions of methods for ventilating the sewer system and flushing the laterals and the mains. Under the head of "Amount of House Sewage" are to be given the probable number of houses connected to the system, probable number not connected, number of office buildings and other business buildings and the percentage of these not connected, a list of the factories, railroads and other important industrial plants now connected and likely to be connected in the future; average amount of water per residential service and by each of the industrial establishments. Length of sewers below permanent ground water level and below temporary ground water level with kinds of joints used, with any data as to infiltration obtained by tests, statement whether rain water or any surface water is admitted to sanitary sewers, whether they are underdrained, by whom house connections are built and precaution to make them water-tight, the size of house connections, the average number of stoppages per year in sewers and in house connections that the department knows of and the chief cause of such stoppages.

Under the head of storm water run-off reaching combined sewers, information is asked as to the chief character of the surface drained, the formula or method used in estimating run-off, and location of each storm water overflow. In case sewage is pumped, give plans and complete description of pumping station, with sufficient data for computing yearly, daily and hourly rate of pumping.

Under the head of "Sewage Treatment," give the kinds of tank used and number of each kind, date of construction, daily quantity of sewage treated, average time in tanks, disposal of effluent and of sludge, volume of sludge per million gallons treated, frequency of emptying tanks, average depth of sludge and thickness of scum when emptied and a description of the method of operation of all alternating or dosing apparatus. If there are filters, give date of construction and describe process, net filtering area in acres, average area of bed in acres and number of beds, description of filtering medium as to quality and depth, average quantity of sewage treated per acre per day, length of dosing time and of resting time for each bed, method of caring for surface of bed and amount of material removed per year, and information as to crops raised if any. Under the head of "Final Disposal" is asked the name of the stream or other body of water into which the sewage is disposed, whether there is a dam across the stream and where located, an estimate of the low water width, depth of flow near the sewer outlet, details as to any probable future use of the stream for water supply, either above or below the sewer outlet.

In describing water supplies the following information is asked for: Population of city at present, date of installing plant and of subsequent extensions, description of any auxiliary supply for fire or for emergency use, and such use by industrial establishments. Under "Source of Supply," name all streams, drainage area above intake, approximate minimum flow, location of intake with reference to the drainage outlets of the city. If from a lake, name of lake, size in acres, average depth and area draining to it. If from an artificial impounding reservoir, area of water surface when full, maximum and average depth, approximate capacity, approximate quantity stored during low-water season, name of stream tributary and its drainage area, the average yearly rain-fall on such area and the nature of the area. Are there any camping or other semi-public grounds on the area? Is the bottom of the reservoir concreted or paved and if of earth, how was it prepared? What measures for protecting the supply from contamination. How often are reservoirs cleaned?

If the supply is from underground, number of wells and diameter and depth of each, character and thickness of the strata passed through by the wells with a description and depth of those from which water is obtained, kind of casing used for drilled wells or kind of walls and method of sinking in the case of dug wells, kind of strainer used, result of tests of yield that have been made, and a large scale map showing general lay-out of wells and other connections. If the supply is from springs or filter galleries or similar devices, the character and thickness of stratum from which springs apparently flow, results of any flow tests made of such springs, and a larger-scale map showing location of springs and of any possible sources of contamination and of works used in connection with connecting the springs to the distribution system. If there are any cesspools or other sources of pollution within 600 feet of the site of the supply, indicate all these on a map of the locality. If there are any salt or oil wells in the neighborhood likely to injure the supply give depth of salt-bearing stratum.

In case of purification, describe the process, future consumption used as basis of design, description of settling basins, kind and number of filter units, effective size, uniformity co-efficient and thickness of the filter sand, head of water maintained above sand, means for maintaining head, normal head of operation, maximum loss of head before filter is washed, means of indicating this loss of head, method employed in washing, capacity of filtered water reservoir and method of covering it. If chemical coagulant is used, means of dissolving it and maintaining solution of known strength, method of calculating coagulant necessary, description of joints where it is introduced and means of introduction. Are regular chemical and bacteriological analyses made and by whom? Does attendant make written record of operation of plant? If hypochlorite is used, date of installing apparatus, description of solution mixer, storage tanks, method of regulating flow, method of introduction into suction main, quantity used per million gallons and method of deciding this and of testing strength of chemical. Are there complaints of bad taste and if so under what circumstances are they most numerous? If liquid chlorine is used,

make and size of machine, point where chlorine is applied to raw water, average amount used per million gallons. If bad tastes have been complained of, under what circumstances? How often are bacteriological tests made to determine efficiency of sterilization and who makes them?

Under "Pumping and Distributing," information is asked concerning the type of pump used, the size or capacity, date of installation, present condition of pumps, suction lift, head pumped against and result of tests of pump slip. Size, length and kind of suction lines and of force mains. Total length of each size of pipe in the distribution system. Methods of preventing freezing of pipes carried on bridges or otherwise exposed. Total number of fire hydrants. Height and capacity of any elevated tank or standpipe, height above business section of city and above highest residence section. How is tank or standpipe covered and can it be cut out in case of fire. In case of a service reservoir, give shape, dimensions, capacity, height of water level above business section and above highest residence section and provision made for cutting out reservoir in case of fire and operating under direct pump pressure.

Water Works Convention*

Conclusion of description of the May convention of the American Water Works Association. Discussion on meters, check valves, pipe joints, pipe coatings, fire hydrants, tastes and odors, meter schedules, and other topics.

This was followed by a topical discussion on various subjects. Discussing the matter of check valves at meters, Mr. Sherman stated that at Belmont, Mass., gas burning under a hot-water heater had been left burning all night and the boiler blew up, and although the town had required a check valve at the meter it disclaimed responsibility for the explosion; the case being still in the court. Mr. Gwinn said that he preferred to burn out a $2 rubber disc occasionally rather than blow up a house and therefore objected to the use of check valves. It was reported that St. Petersburg, Va., requires check valves at meters. It was reported from Gary that meters there had been damaged by hot coils in furnaces which in winter created large amounts of steam; also that relief valves were thought desirable in connection with check valves but that a reliable relief valve had not been found, they usually corroding shut from long periods of non-use. It was also reported that in that city there had been numerous complaints by consumers who had been given bills for damages to meters by hot water. E. E. Davis stated that in Richmond he had used hot water meters and had found them not to be damaged by hot water; but Mr. Hawley stated that he had tested such meters and found them not reliable in the measurement of water.

The use of double check valves between public and private services was then discussed and Stephen H. Taylor of New Bedford stated that they had in use such valves ten years old, and that all such valves were tested yearly and that they had never yet found both the checks leaking. One member pointed out, however, that a long stick or piece of rope, such as they had found at times under one of the valves, might have been carried a little further and prevented both valves from closing. Mr. McInnes said that double checks could not be considered reliable without inspection and he felt that the responsibility was too great to trust to inspection which sometimes might fail, and that such construction was not allowed in Boston. Mr. Burnham stated that at the Conference of State Sanitary Engineers at Boston last year the conclusion was reached that such valves may be proper under certain conditions. W. C. Miller of St. Thomas stated that that city required a check to be placed wherever water was supplied to a building from an overhead tank, even though that tank was filled from the city mains, because of the possibility of pollution of the tank from the outside.

Discussing methods of constructing mains under railroads, J. E. Gibson described the practice of placing one pipe inside of another larger pipe which takes the vibration. At Gary the practice was said to be to place the pipes 8 feet deep beneath the rails, the additional depth of ground absorbing a large part of the vibration, and that they had had no trouble with pipes so laid. Mr. Hawley stated that at Atlantic City there had been no trouble with railroad crossings since leadite was used for joints.

Discussing the subject of lead substitutes for joints, Mr. Gwinn stated that he had tried leadite for a short time but had returned to the use of lead. However, most of those who spoke on the subject stated that they were convinced of the desirability of using such substitute. Mr. Hawley referred to 75 miles of pipe laid with leadite which had given entire satisfaction, the cost of such joints being 60 per cent less than that of lead during the war. Old joints had been dug up occasionally and had always been found in perfect condition. These mains were under pressures running up to 210 pounds and in pipes of sizes varying from 4 inches to 36 inches. He stated that it was desirable to use a pouring gate 8 to 10 inches high for satisfactory results. Mr. Gibson had used leadite for four years with entire satisfaction after he had got used to it. He found, however, that leaks in leadite joints, which were more or less numerous when the joint was first poured but which usually took up in a few hours or days, would not take up if the water was of a nature that would not rust iron, citing one experience with such water. Mr. Hawley cited one length of 7800 feet of 6-inch pipe laid with leadite and which was tested six months later when an opportunity offered and a leakage found of only .06 cubic feet in ten minutes. Another member stated that a 16-inch main laid under tracks which had given trouble by leakage had been caulked with leadite and leakage prevented; and that pipes laid over bridges with the joints in view and caulked with leadite had shown no leakage. G. G. Dixon told of 2000 feet of 10-inch pipe laid with leadite in February 1921 and when tested under 100 pounds pressure the metered leakage showed 500 gallons per day per inch per mile, which fell to 250 gallons and ten days later to below 200 gallons which was their specified limit. J. A. Jensen told of laying

*Continued from page 406.

some 6-inch pipe on top of the ground for temporary service during the tearing up of a street, part of this line being laid with lead and part with a lead substitute (not leadite), which line was in service 90 days, and while all the lead joints were dry only 2 out of 90 joints made with lead substitute were passable. S. H. Taylor told of a test of six pipes jointed together, three joints being made with leadite and three with another substitute, which line of pipe was lifted at one end while the other rested on the ground and the joints had developed considerable elasticity, and after this harsh treatment, the joints were still found to be tight. He had used leadite for three years almost exclusively and calculated that he had saved 75 per cent of the cost of joints.

In discussing the matter of location of fire hydrants, Mr. Bohmann of Milwaukee stated that in that city, water works and other municipal utilities were considered to have precedence over all private structures, and that if the city wished to put a fire hydrant at a corner where poles were located, the poles had to be removed.

In discussing the use of fire hydrants, Mr. Saville stated that they had found that a record of the year 1921 showed fire hydrants in his city used 74,500 times by the street department and only 171 times by the fire department and now were endeavoring to collect from the former department a considerable part of the cost of maintaining hydrants, which was about $4.75 per year per hydrant. It was stated that in St. Paul, stillson wrenches were used by contractors to the damage of the hydrants and that two crews of men were kept continually on the ground inspecting and repairing the 4,000 hydrants and that the cost of maintaining them was about $14 a year. A. B. Stiles stated that his city required contractors to install service connections with the water mains before starting the constructing of a building in order that such service could be used in the construction, and that contractors were not allowed to use fire hydrants. Mr. Gwinn stated that in his city all water used for street construction work was taken through a one-inch meter and charged for, the charge being $36, the regular schedule rate for water. Mr. Bohmann stated that his city discouraged the use of hydrants by contractors but could not refuse them; they were required to take out a permit and were loaned the wrench for opening the hydrant, which wrench was returned when their work was completed and their deposit recovered. He stated that they never yet had found that the fire department had failed to put out a fire because of any injury done to a fire hydrant by the contractor.

George E. Cripps, superintendent of the Water Works Repair Department of Rochester then read a paper entitled "Equipment and Shop Facilities for Maintenance of Water Works Systems," which was told in an entertaining way that caused considerable laughter but gave many valuable suggestions on the maintenance of water works. For instance, at one time he was called out at 2 a. m. by a serious break in a 36-inch main. Being by himself unable to close the valves controlling the ruptured section and realizing that it would require several hours to get his own men on the job, he called on the fire department for assistance in closing the valves. While speaking of valve closing he stated that the city owned a valve closing appliance attached to an automobile similar to that used in a number of cities. During the reading of the paper he showed slides of this and a number of other appliances. One among these which he especially commended to superintendents was a portable coal-burning boiler mounted on a light automobile truck, this boiler furnishing 60-pound steam which was used for a variety of purposes, such as thawing out fire hydrants, thawing snow over valve boxes and numerous other uses in winter, including use by the fire department for thawing frozen hose connections when reeling up the hose, thawing out extension ladders when lowering them after a fire, etc. The department now occupies with its shops a building 212 feet by 42 feet, adjacent to which is a pipe yard 350 feet long. The machine shop contains the latest facilities for metal working, including an acetylene welding outfit by means of which fire hydrants broken by automobiles have been mended. Mr. Cripps said that he uses leadite and swears by it. As an illustration of his statement that most anything could happen in a water works system, he cited the case of a service that was found frozen in July, explaining that the service lead into an ice cream manufacturing plant and had been laid next to an ammonia pipe which had started to leak.

P. J. Dooley advocated educating school children to a knowledge of the water works system of their city, not only for the benefit it would have when they grew up, but because of the immediate effect in their taking the information home to their parents. He arranged with the teachers of the public schools in his city to send the children to the water works plant, a class at a time, where they would be shown around the plant and have the various features explained to them. Another member stated that he also had children sent to the plant and the teachers required them on returning to write compositions describing what they had learned there. C. W. Newell commended this not only for its educational but also for its advertising feature, believing that if the water works department advertised itself and made as much noise doing its work as does the fire department it might be able to get appropriations from the city councils more readily.

"Present-Day Tars for Pipe Coatings" was then read by W. R. Conard, following which the topics printed in the suggestions for Superintendents' Day discussions were taken up seriatim. The first of these dealt with methods of preventing tampering with water meters. A paper on this subject was read by William W. Brush describing seals used in New York City furnished by the International Seal and Lock Co. which, although quite elaborate, it was learned could be tampered with in three ways. In fact, it seemed almost impossible to devise a seal that would absolutely prevent interference with a meter without detection.

Several members gave items of information from their own sections concerning the ownership of and payment for service pipes. Mr. Bohmann stated that in Wisconsin the public service commission does not give credit for services to a company where such services were paid for by consumers, even though the company claims ownership to them. Apparently the practice in the majority of cities is for the com-

pany to lay the services to the curb and the consumer from there to his property. In most cities the water company or department does not allow anyone to tap the mains except a representative of the company or department. St. Paul requires a consumer to pay for the service and to use the kind designated by them, and then guarantees the service for thirty years.

Discussing the subject of the cleaning or sterilizing of pipes before laying them or after they have been laid, Mr. Brush stated that in New York chloride of lime is placed in each pipe before it is laid in the trench. After a line has been completed, water is flushed through it and out of the nearest fire hydrant and water from the line is tested for B-coli, and the line is not put into service until such test is satisfactory. Following the break in the supply main across the narrows to Staten Island, when the pipe was filled with sewage-laden water from New York bay, a chlorine plant was established on the Brooklyn shore and chlorinated water was pumped through the repair main at the rate of 13,000,000 gallons a day, using 150 pounds of hypochlorite in ten hours and the water coming through the main was tested until it showed satisfactory freedom from bacteria.

FRIDAY SESSIONS

Friday morning's session was a joint one with the chemical and bacteriological section and was devoted to papers and discussions on chlorination and the removal of odors by aeration. Frank E. Hale, director of laboratories for the water department in Brooklyn, N. Y., described the excess chlorine method of plant control of chlorination. He recommended the use of .1 excess after ten minutes rather than .2 after five minutes. The excess chlorine method of control is now used, although previously the supply had been controlled by bacteriological tests.

William W. Brush read a paper entitled "Responsibility of the Water Works Superintendent to Prevent Tastes and Odors Due to Microscopic Organisms," in which he described the experiences of New York City in its efforts to eliminate tastes and odors, especially the rather serious ones that developed a few months ago. Copper sulphate had been applied in the aqueduct rather than to the large reservoirs, at the rate of 1 to 2 pounds per million gallons. This sometimes occasions some taste in the water, but this had been removed by chlorine. (Mr. Hale in his paper stated that the use of chlorine at .28 parts per million excess destroyed the cucumber taste contributed to Brooklyn water by algae.) Mr. Brush had not found that copper sulphate killed fish, but once or twice they had been smothered by large amounts of amorphous matter that collected on their gills, this matter being derived from the algae that had been killed by the copper sulphate. In the discussion on the matter of odors, Pat Gear told how a skunk had once been killed in the Holyoke reservoir and an hour and a half later they had to tell the telephone operator that the water works telephone was temporarily discontinued, as the taste seemed to have penetrated to all parts of the city. Mr. Hazen told of an experience with a reservoir which he did not name where the decomposition of algae that had been killed by copper sulphate produced taste results in the water that were very much worse than the original tastes.

The author of a paper scheduled to give further information concerning chlorine control at Grand Rapids was not present. Norman J. Howard read a paper describing recent practice in the removal of odors by aeration, filtration and other processes, and William J. Orchard described and illustrated by lantern slides some of the more recent developments in chlorination.

At this session the question was brought up as to the advisability of continuing the experiment made this year of having regular sessions of the convention on Friday. A vote by those present was almost unanimous in favor of the Friday sessions; although from the fact that the vote was taken at a Friday session it would seem to be natural that most of those present would favor it or they would not have been there.

The last session of the convention, on Friday afternoon, opened with the reading by Isaac Walker of the report of the Committee on Standardizing Meter Schedules, of which Allen Hazen was chairman. This was a preliminary report that it was hoped would bring out discussion by the members in order that final action could be taken next year. It was devoted largely to the slides in meter schedules. The report stated that the rates in some cities varied as much as 10 to 1 between the extremes which seemed to be highly undesirable. The schedule recommended by the New England Water Works Association and used by companies supplying two million people was recommended by the committee, it having been in use for six years. Each of the members of the committee of the New England Water Works Association that had recommended this standard was questioned and replied that he had no changes of any consequence to recommend. This schedule divides the consumers into domestic, those consuming up to 300,000 gallons per year; intermediate, those consuming between 300,000 and 3,000,000 gallons; and manufacturing or wholesale, consuming over 3,000,000 gallons. It was believed that the ratio between the domestic and the manufacturing rates should not exceed two to one. The use of the service charge in meter rates had been approved recently by the public service commission of New Jersey, Pennsylvania and California. Discussing this, Mr. Gwinn claimed that the use of a service charge encourages waste, since the charge for the water itself was so low as to be no deterrent, but most of the members apparently did not agree with him. Another suggestion which did not find any backers was made by Mr. Trautwine—that cities furnish free water to domestic consumers, the water being purchased wholesale from private companies for this purpose when the plant was not municipal.

Two papers were down on the program each entitled "Steel Pipe," but the author of only one of them was present, Theodore A. Leisen. The last paper of the convention was one by William A. Megraw, entitled "Design, Construction and Operation of a Balancing Reservoir." This was illustrated by lantern slides and explained the somewhat novel design of the plant. This paper we expect to present in PUBLIC WORKS shortly.

Water Works Services

Continuation, from the May 13th issue, of tables prepared from data furnished by superintendents of nearly eight hundred cities concerning meters, and the material, deterioration and clogging of services.

Note: In the table, ci. means cast iron; cl., cement lined; gi., galvanized iron; gs., galvanized steel; gwi., galvanized wrought iron; i., iron; ll., lead lined; s. steel; wi. wrought iron.

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
Nebraska:					
Aurora	ci., g.	l., 30+	.....	no	.....
Chadron	l.	....	.....	no	.....
Fairbury	gs—no pav.	10	rust	no	renew
Fremont	l., g.	l.-20, wi.-22, g.-20	rust on i.; corrosion or chem. action of water on l.	yes	take up and clean
Gering	i.	....	ord. decay	no	.....
Hastings	l.	....	.....	no	.....
Lincoln	l. and g. (h)	18	rust, little elect.	no	.....
McCook	l.	....	.....	very little	.....
North Platte	l.	s., 7-10	rust and action bet. brass on goose necks and iron pipe	no	.....
Schuyler	wi. and l.	....	.....	no	.....
Sidney	g.	20	rust	no	.....
University Pl.	g.	15	rust	no	.....
New Hampshire:					
Berlin	s., wl.	22	rust	some	renew
Claremont	g., ll., cl.	g., 15-18; cl., 30	rust	with rust	relay new
Concord	wi., cl.	40	rust	yes	force pump and wiring out
Dover	wl., cl.	34+	outside by rust	some	put in new
Keene	s. and wi.	30	rust	no	small paper or wire
Lebanon	s.	20-25	rust	some	replace with new
Pembroke	s.	20	rust	only rust	renew
Portsmouth	wi.	15	rust	no	.....
New Jersey:					
Boundbrook	s. or wl.	30+	.....	no	.....
Bridgeton	l. and g.	12-15	rust	yes	take them out
Dunellen	wi.	....	elect.	no	.....
Freehold	wi.	formerly used s.-15	rust	no	.....
Hawthorne	s.	...	rust	no	.....
Hightstown	s.	12	rust	no	.....
Milltown	l.	formerly g., 4-6	rust and action of soil	no	.....
Nutley	wi., l. goose necks, brass corp. and curb cocks	20	corrosion	no	.....
Phillipsburg	g. wi.	15-25	elect., rust	no	.....
Ridgewood	ll. g.	g.-25	rust—plain g.	...	.....
Rockaway	g. wi.	20	rust	no	.....
New Mexico:					
Silver City	g.	20-30	rust	no	.....
New York:					
Albany	l.	50	elect.	seldom	force pumps
Amityville	g.	...	rust	yes	renew; run chain thru
Auburn	g.	25	rust	no	.....
Avon	l. and wi.	l. 50, wi. 20	.....	no	.....
Babylon	g.	25	rust	yes	.....
Baldwinsville	g. wi.	30-35	.....	no	.....
Brockport	wi.	....	rust	not often	relay service
Buffalo	i., g. or l.	20	elect., corrosion	occasionally	force pump
Canastota	l.	50	clog. w. hard water deposits	yes	.....
Catskill	l.	....	.....	no	.....
Clyde	g. wi. and l.	g., wi.-10	rust	no	.....
Corning	wi.	30-50	rust	no	.....
Cortland	ci. main wi. serv.	wl.-40+	elect.	no	.....
East Aurora	g., ll.	....	.....	little	air pressure
Elmira	l.—pav. sts., wi. elsewhere	wi.-40	rust	rarely	renew
Fairport	l.	....	.....	no	.....
Fort Plain	gs.	20-25	rust	no	.....
Frankfort	l.	i. (former)-25	rust	rarely	.....
Freeport	wi.	....	rust	over pitting	renewal
Geneva	l.	lifetime	.....	no	.....
Glens Falls	wi., l. connection	15-30	internal rust and stoppage by sediments in water	old serv.	tissue paper slugs and force pump; renewal
Gloversville	l.—formerly g.	g., 8-15	.....	yes	renew with lead pipe
Hamburg	s. and wl.	s., 15-25	rust mostly	no	.....
Hoosick Falls	g.	15-30	rust	some	.....
Hudson	l.	....	.....	no	.....
Hudson Falls	cl.	....	.....	...	.....
Ithaca	l., ¼" up—cl.	....	elect.	prac. none	.....
Jamestown	wl.	25	rust	seldom	force pump; wad of paper
Le Roy	wi.	16-18	rust	no	.....
Lyons	g., wi.	....	.....	...	.....
Middletown	brass and l. on pav.; wl. on others	wi., 15; others, 20-30	rust	no	.....

(h) Lead pipe across streets and alleys; galv. iron from lot line into building.

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
New York (Continued).					
Mohawk	g.	20	rust	no	.....
Mount Morris	wi., s.	30	rust	no	.....
Mount Vernon	l.; old-wi.	wi.-20	elect.	yes	renew with l.
New Albion	g., wi.	15	elect.	...	force pump
Newark	g., wi. and l.	20	rust gen., elect.	no	.....
New York	up to 2"-l.; 3" up-l., g. and ci.	g., 20-30	rust, little elect.	g.—yes	replaced with new
Norwich	gs.	20	rust	no	.....
Ogdensburg	g., wi. and g. ll.	25-30	rust	yes	renew
Olean	l. and g.	....	rust, elect.	no	.....
Oneonta	l. and wi.	l.-50 wi.-20	rust—wi.	no	.....
Ossining	l.	30+	.....	yes, at curb cocks	dig up and punch out corp. cocks; renew g. pipe from curb cock to bldg.
Oswego	l.	....	.....	no	.....
Perry	wi.	s.+ 6-10 26+	rust	no	.....
Rochester	l., g., ll.	....	.....	little	blow them out
Salamanca	gs.	10-15	rust	no	.....
Saratoga Springs	wi.	....	.....	no	.....
Scotia	l.	....	none	no	.....
Seneca Falls	g. wi.	g.-20	rust	no	.....
Sidney	g. and l.	g.-18	rust	no	blow offs
Syracuse	up to 1"-l.; over—g.	....	2 from elect.	no	.....
Tarrytown	up to 1"-l.; over, ci. or wi.	....	.....	no	.....
Wappingers Fls.	i. and l.	....	.....	no	.....
Waterford	wi. and l.	....	rust from outside	no	.....
Waterloo	wl.	8	elect.	no	.....
Watertown	g. wi.	15-20	rust	yes	relaying
Watervliet	l.	20	elect.	no	.....
Wellsville	wi.	25	rust and sediment	some	renewal
Westfield	wi.	25	elect. and rust	no	.....
Yonkers	l.	....	.....	occasionally	pressure pump
North Carolina:					
Canton	g.—serv.	g., 10-15	rust	no	.....
Greensboro	wi.	15-20	elect.	no	.....
High Point	g.	20	rust	little	.....
Lenoir	l.	....	.....	no	.....
Monroe	g., wi., l. gooseknecks	20	rust	no	.....
Morehead City	wi. and l.	....	.....	no	.....
Mount Airy	wi. g.	18	rust	no	.....
New Bern	g.	10	rust	...	.....
Rocky Mount	g.	20+	rust	small serv.	renew
Salisbury	s.	15-20	rust	yes	renew small ones
Wilmington	g., l. connections	30	.....	yes	renew
North Dakota:					
Fargo	under 2"-l.; over—ci.	40+	sulphates in soil	no	.....
Grafton	l.	....	.....	no	.....
Valley City	l.	....	defective material	no	.....
Wahpeton	l.	....	.....	no	.....
Williston	l. and i.	i., 10; l., 25	rust	no	.....
Ohio:					
Ashtabula	s.	15	electrolysis	...	.....
Barberton	wi., l. gooseneck	....	.....	some	force pump
Barnesville	i. and l.	i.—10	.....	no	.....
Bryan	l.	....	.....	no	.....
Cambridge	wi.; now l.	10—15	rust	yes	wire
Cincinnati	l., ci., brass	....	.....	very little	.....
Cleveland	l. to curb; g. to house	1—40	g., rust; l., elect.	occasionally caused by small fish	force pump
Cuyahoga Falls	wi. and l.	....	elect. and cinders	some	air; wire; digging up
Dayton	l. to prop. line, g beyond	wi—50	.....	no	.....
E. Liverpool	l.	....	.....	no	.....
E. Youngstown	l.	....	.....	no	.....
Eaton	l. and wl.	30+	one case of elect.	no	.....
Franklin	l.	40—50	electrolysis	no	.....
Kenmore	l.	....	.....	no	.....
Lakewood	up to 1"—l.; up to 2"—wi.; 3" and up—ci.	....	electrolysis	no	.....
Lancaster	l. and i.	22	rust principally	slightly	open, blow out or muriatic acid
Lima	l.	....	elect., sewers settling	no	.....
Lorain	l.	....	electrolysis	no	.....
Marysville	i. and l.	l.—10	rust	some	renew
Medina	wi. and l.	20+	cinders eat away l.	no	.....
Middletown	l.	....	backing up of pipe across sewer ditches	no	.....
Mingo Junction	s., wi., l.	s., 6; wi., 12; l, 15	i. and s.—rust; l.; wear and excessive pressure	no	.....
Montpelier	s. and l.	s—10	rust	no	.....
Newark	wi.	20	elect., rust	no	.....
New Boston	l.	....	electrolysis	no	.....
New Philadelphia	s.	....	rust	...	.....
Niles	l.	....	electrolysis	no	.....
Portsmouth	l.	....	electrolysis	no	.....
Sandusky	l.	25+	electrolysis	no	.....
Springfield	l. and g.	....	electrolysis	no	.....
Tiffin	l. to curb stop	....	.....	no	.....
Wadsworth	g., l. conn.	15	external corrosion	not recently	flushing
Warren	l.	35+	elect.; sew chocked up	...	relaying
Willoughby	g., l. gooseneck	....	rust	no	.....
Youngstown	l. to curb; rest—g	up to 50	natural deterioration	some	replace
Zanesville	l.	....	sediment	yes	.....

Table II—Water Works Services—Continued

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes: Does it occur?	Clogging of service pipes: Method of removal.
Oklahoma:					
Cleveland	wi.	10	rust	yes	air pipe
Collinsville	gs.—serv.; ci.—mains	s—2½	rust from outside	no	.....
Hartshorne	s., wi., l.	g. 5; l. 15	g—rust	no	.....
Holdenville	wi. and l.	11—15	rust	no	.....
Newkirk	l.	....	.....	no	.....
Sand Springs	s.	....	.....	no	.....
Pennsylvania:					
Allentown	l. up to 2"; ci.—above	40-50	elect.; rust old ci,	no	.....
Bloomsburg	ci.	40	not generally	no	.....
Catasauqua	wi.	20	rust, elect.	no	.....
Chambersburg	s., l. and g.	i., 35-40; s., 12-15	rust	...	renewal
Chester	l. and g.	....	rust	...	renew
Coatesville	l.	....	.....	no	.....
Connellsville	wi.	5-10	gases from coke cinders	very little	renew small lines
Condersport	wi.	25	rust	no	.....
Corry	wi.	25-50	cinders	no	.....
Downingtown	l.	....	.....	no	.....
Duquesne	l.	20	electrolysis	yes	hand pump and wire
Elwood	l.	....	.....	no	.....
Emans	wi.	wi. 30	rust	no	.....
Hamburg	ci. and l.	lifetime	corrosion from ashes	no	flushing
Honesdale	ci., l.	....	rust	no	.....
Huntingdon	wi., g.	20	acid corrosion	no	.....
Indiana	ci.—large g., ll.—small	5-100 ci. 15-40 g., ll.	rust	some	.....
Jenkintown	l. to curb; g. to house	g. 20	rust	...	renewal
Jersey Shore	ll., wi.	wi. 15	.....	yes	.....
Juniata	wi.	26+	rust	no	.....
McDonald	l.	26+	.....	no	.....
McKees Rocks	l.	30	elect., frost, accidents	no	.....
Manheim	g.	15	rust	no	.....
Media	l. to curb	...	.....	no	.....
Meyersdale	wi.	25	elect., rust	not much	force pump
Millersburg	wi.	25-30	corroding and filling up	not often	take out
North East	l. and wl. g.	25	rust, corrosion	seldom	replace
Reading	l., wi., ci., ll.	...	rust	...	.....
Red Lion	wi., l., s.	wi. 30-60 l. 15-25	rust	no	.....
Reynoldsville	l., wi., s.	10-15	.....	no	.....
Royersford	l. to curb, wi. to house; some s.	wi.-30 s., 12-15	l.-elect; rust, i. and s.	no	.....
Sayre	wi., s.	20 s.	.....	no	.....
Sharpsville	wi., ci.	10-12	s.-rust	yes	new serv.
Sykesville	l.	10+	lime in water	no	.....
Tamaqua	wi. and l.	wi., 15	no	not much	none cleaned
Tyrone	g. ll.	20	elect., rust	no	.....
Unlontown	i., l. to curb	l., 25-30 i., 7-10	rust elect.	yes	put in new ones
Warren	l., formerly g.	g.-18	corrosion	from corrosion	rebuilt or replaced with l.
Wellsboro	wi.	wi., 36; p., 10-15	rust	no	.....
Wilkinsburg	l.	....	deterioration of wiped joint; expansion of pipe due to water hammer or frost; too light pipe used	some	wire, paper, plug, shot, iron chips
Williamstown	ci.	....	corrosion	...	.....
York	l.	g., 14; l., 30	rust. elect.	no	.....
Rhode Island:					
Woonsocket	l.	35	.....	little	Put in new. Also dig corp. and stop and waste and force paper through
South Carolina:					
Anderson	l. under pav.; l. and i. unpaved	....	elect.; poor wiped joints	no	.....
Batesburg	g.	....	.....	no	.....
Bennettsville	g., l. gooseneeks, brass connections	l.-10	corrosion	no	.....
Camden	g., wi.	20	rust	...	.....
Charleston	l.	....	elect.	some	clean corp. cock
Cheraw	g.	10+	.....	no	.....
Clinton	wi.	20	rust	no	.....
Easley	g.	....	.....	no	.....
Spartanburg	g.	....	none	no	.....
South Dakota:					
Aberdeen	l.	....	rust, l.	no	.....
Tennessee:					
Elizabethton	wi.	14+	.....	no	.....
Erwin	wi., g.	....	.....	little	replace
Greeneville	wi. and l.	wi., 25-30	rust; chemical action of water	no	.....
Lebanon	ci., g.	ci.-43, g.-20	rust	no	.....
Memphis	l.	....	.....	few cases	pressure pump
Newport	l., wi.	....	.....	no	.....
Shelbyville	l., ci.	....	.....	...	.....
Trenton	wi., l.	i.-20	rust	no	.....
Texas:					
Austin	wi. and l.	wi.-15	rust, leakage	not serious	.....
Big Spring	wi., cl.	20	rust	no	.....
Cleburne	wi., s., l.	i. and s., 10; l., 15	i. and s., rust; l., elect.	no	.....
Cooper	wl.	....	.....	no	.....
Dalhart	s., wi., l. cl.	....	.....	...	.....
Electra	g.	....	.....	no	.....
Hearne	l.	....	.....	no	.....
Henrietta	s. and l.	s., 4-10	rust	no	.....

Table II—Water Works Services

Municipality	Materials used for services.	Average life before renewal years.	Cause of deterioration.	Clogging of service pipes—Does it occur?	Clogging of service pipes—Method of removal.
Mart	ci., s.	s., 12-15	.....	no	.....
Paris	l., pav. sts; g., unpaved	....	l., rust	no	.....
Quanah	l.	....	.....	no	.....
San Antonio	g.	....	.....	...	.....
Smithville	wi.	10-12	rust	no	.....
Stamford	wi., l.	wi., 10-20	.....	no	.....
Sweetwater	l., ci.	....	.....	no	.....
Teague	l.	....	.....	no	.....
Texas City	g., wi.	12+	rust; some elect.	no	.....
Waco	l., perm. pav.; wi., others	wi., 15	rust; chemical in soil	yes	replace with new
Vermont:					
Barre	g., wi.	30+	rust	very little	force pump
Proctor	g.	24+	.....	no	.....
Springfield	g., wi.	....	.....	very little	.....
Virginia:					
Charlottesville	wi.	18	rust	yes	renew
Harrisonburg	g.	20	rust	very little	.....
Lynchburg	l., perm. pav.; wi., elsewhere	l.-20	elect., rust	...	hand force pump
Martinsville	s.	20	rust	not much	.....
Richmond	l.	25-50	earth action, occasionally elect.	very little	force pump
Staunton	g., wi.	....	elect.	no	.....
Washington:					
Seattle	g., wi.	25-35	elect.	seldom	force pump
Spokane	s., g.	50	elect., rust	no	.....
West Virginia:					
Charleston	g.	15-30	elect., filled land, loose soil or cinders	some	with heavy wire while pressure is on
Moundsville	l., wi.	20	elect., some bad ground, some bad pipe	some	run heavy wire through
Salem	wi.	10	rust	yes	take up and ream out
Sistersville	g.	15	elect., corrosion	yes	pump l. lines; discard g. lines
Welch	s. and l.	s.-12	rust and scale	yes	.....
Wisconsin:					
Appleton	l.	....	elect.	no	.....
Clintonville	l.	l.-12	rust	no	.....
Delavan	l.	s., 10-15 wi., 20-25	.....	no	.....
Fond du Lac	s. and l.	10	rust	no	.....
Fort Atkinson	l., s.	s-15	rust	no	.....
Green Bay	l.	wi. and g.-25	elect. on old g. and wi.	no	.....
Hartford	l.	wi.-10	rust	yes	dig up and clean with wire
Janesville	l.	wi.-12	rust	no	.....
Jefferson	l.	20+	.....	no	.....
Kaukauna	l.	....	elect. in one case	no	.....
Lake Geneva	l.	....	no	some	by filling pipe foot or two with bread and putting on pressure pump
Madison	l., up to 2" ci., above 2"	....	.....	no	.....
Manitowoc	l.	....	.....	no	.....
Marinette	gs. and l.	gs.-25	rust and blowing out of lead connections	no	.....
Menasha	l. to 2" ci., larger	50+	.....	no	.....
Milwaukee	l. to 2" ci., larger	50+	elect. only	no	.....
Mineral Point	l.	....	.....	no	.....
Monroe	l.	....	.....	no	.....
Neenah	l., main to meter	wi., 3-10	city soil—pipes pit from outside	some	clean. corp. cock
New London	l.	g.-10	g.-rust	no	.....
Park Falls	wi. and l.	....	.....	no	.....
Platteville	l., brass connections	....	.....	no	.....
Plymouth	l.	....	elect.	...	.....
Racine	l.	....	few cases of elect.	no	.....
Reedsburg	s. and wi.	s.-15	rust	no	.....
Rice Lake	s.	20-30	rust	once in a while	flushing
Richland Center	l.	25	.....	no	.....
Shawano	l.	l., 10-15	rust	no	.....
So. Milwaukee	l.	20	elect.	no	.....
Sparta	ci., l.	....	none	yes	flush fire hydrants
Stevens Point	gs.	30	rust	yes	new service
Sturgeon Bay	l.	....	.....	...	.....
Superior	l., serv. in sts. g. or l. for others	l.-indef.	elect., rust	no	.....
Tomah	g., wi., gs.	gs., 12-15	rust or corrosion	no	.....
Tomahawk	ci.	....	.....	no	.....
Viroqua	l., s.	s.-10	rust	no	.....
Watertown	l.	unlimited	.....	...	force pump, bread and water
Wauwatosa	l.	....	none	no	.....
Wyoming:					
Cheyenne	l.	Indef.	elect.	no	.....
Evanston	g.	30	rust	no	.....
Rawlins	l. and g.	10	l., rust	no	.....

NEWS OF THE SOCIETIES

CALENDAR

June 12—AMERICAN FEDERATION OF LABOR. Cincinnati, Ohio.

June 12-15 — CANADIAN GOOD ROADS ASSOCIATION. Ninth annual meeting. Empress Hotel, Victoria, B. C. (Change of date.)

June 13—ENGINEERING SOCIETY OF AKRON. Akron, Ohio.

June 15—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

June 16-17—ENGINEERING INSTITUTE OF CANADA, Provincial meeting. Vancouver Hotel, Vancouver, B. C.

June 19—AMERICAN CONSTRUCTION COUNCIL. Organizing meeting. Washington, D. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention. Crookston, Minn.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

July 12-14—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Exhibition. Auditorium Bldg., Springfield, Mass.

Aug. 15-18 — INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28 — SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

THE AMERICAN CONSTRUCTION COUNCIL

The American Construction Council, which will meet in Washington June 19-20, has been organized to bring together the many component parts which make up the industry, to analyze their common problems and provide a satisfactory solution for them.

Noble Foster Hoggson, New York, says: "The 250 national associations in the industry have discovered a considerable amount of duplication of effort and their inability to grapple effectively with the problems that extend beyond their own special fields. Each is ready and anxious to submit its common problems to an all-embracing organization which will strive for an elimination of duplication and waste and for more effective work. . .

"The first efforts of the Council will be devoted to:

"The formation of a code of ethics acceptable to the industry and to the public;

"The gathering of adequate statistics so that the industry may operate intelligently.

"A reduction of the national shortage of building mechanics and the establishment of the necessary apprenticeship system;

"A national study of building codes and the working out of a program for carrying the recommendations into effect;

"A revision of the existing freight rates on construction materials;

"A stabilization of the construction industry to mitigate the evils of seasonal employment and the trade migration of labor."

Other subjects under consideration at this meeting included, "The Need for a Universal Contract Form"; "The National Board for Jurisdictional Awards"; "National Construction Industrial Board"; "Construction Materials Forum"; "Estimate Guide Sheet, Standard Cost Finding System, Standard Form of Financial Statements, and Equipment Rental Agreement"; "Apprenticeship, and the Shortage of Skilled Workmen."

U. S. CHAMBER OF COMMERCE

The tenth annual meeting of the Chamber of Commerce of the United States was held at Washington, May 15-18. The keynote of the meeting was European conditions and their effect on American business, and it was addressed by President Harding, Secretary Hughes and Secretary Hoover. Officers elected were, president, Julius H. Barnes of Duluth, Minn.; vice-president for the Eastern States, A. C. Bedford of New York; for the Northern States, Thomas E. Wilson of Chicago; for the Southern States, Harry Black of Galveston and for the Western States, Thomas P. Stearns of Denver. Honorary vice-presidents elected were William Butterworth, Moline, Ill., and L. M. Gillette, Minneapolis.

CONFERENCE OF STATE SANITARY ENGINEERS

At the conference of State Sanitary Engineers held at Washington, D. C., May 16 and 17, C. A. Emerson, Jr., Harrisburg, Pa., was re-elected chairman; W. H. Dittoe, Columbus, Ohio; vice-chairman, and Theodore Horton, Albany, N. Y., secretary-treasurer.

THE ASPHALT ASSOCIATION

The following officers and directors have been elected for the ensuing year: President, Joseph R. Draney, U. S. Asphalt Refining Company, New York; Vice-President, F. P. Allen, Standard Oil Company of Indiana, Chicago, Ill.; Treasurer, Herbert Spencer, Standard Oil Company of New Jersey, New York; Secretary, J. E. Pennybacker, New York. Executive Committee: J. R. Draney, Herbert Spencer and LeRoy M. Law. Directors: Henry Fisher, Herbert Spencer, J. R. Draney, F. A. Hogan, J. S. Helm, E. J. Morrison, F. P. Allen, L. M. Law, L. M. May, G. H. Perkins, W. T. Headley, Charles Hvass, H. W. Wilson, B. F. Richardson and W. S. Ely.

During the past year the Asphalt Association has been expanded with the addition of about forty new members and by opening branch offices at Atlanta, with James R. Valk in charge as district engineer; at Raleigh, N. C., with Harry P. Grier as district engineer, and at Newark, N. J., with Frederic A. Reimer as district engineer. The Canadian office was moved from Toronto to Albany, N. Y., where Germain P. Graham was put in charge as district engineer. The association has maintained an office in Chicago with John B. Hittell in charge for several years.

In his annual report Secretary Pennybacker of the Asphalt Association declared: "In the face of the general business depression, asphalt paving had its banner year in 1921 with an estimated total yardage of 68,000,000, thus leading all competitors among the types higher than waterbound macadam. While it is generally believed that the asphaltic types make their gains largely in cities the Federal aid mileage of the bituminous types in 1920 was 602.7 miles. In 1921 the mileage was 1,018.3 miles, an increase of 415.6 miles or 48 per cent.

ENGINEERS' SOCIETY OF PENNSYLVANIA

The Engineers' Society of Pennsylvania has elected the following officers: president, T. E. Seelye, first vice-president, R. W. Moorehead; second vice-president, William Brown; secretary, Howard E. Moses, and treasurer, Harry T. Neale.

NEW YORK SECTION, A. S. C. E.

The annual meeting of the New York section of the American Society of Civil Engineers was held on May 17, at which was discussed regional planning for the New York district. The following officers were elected: president, J. Vipond Davies; vice-presidents, F. C. Noble and Charles W. Leavitt; secretary, H. M. Lewis, and treasurer, C. R. Hulsart. The new directors are W. G. Grove and W. C. Briggs.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

LARGER SIZE P. & H. CORDUROY EXCAVATOR CRANE

After nearly two years' service in the U. S. Government Reclamation Service, a larger size Corduroy Excavator Crane similar to Numbers 205 and 206, has been standardized upon by the Pawling and Harnischfeger Co.

This machine is able to handle a 1-yard Page dragline bucket on a 35-foot boom, a 3/4-yard Page bucket on a 40-foot boom and a 1/2-yard Page bucket on a 50-foot boom. It will also handle clamshell buckets of from 1/2 to 1 1/2 yards capacity, depending upon the reach and the material handled. With but a few unimportant changes the 208 can be converted into a powerful gas shovel, handling a 1-yard dipper, and can be used with backfilling scraper, crane hook or electric magnet. This is the largest capacity machine that can be loaded onto a railway car to come within Standard Railway clearances without dismantling.

It is of the full revolving type mounted on full corduroy traction, is one-man operated and is of all steel construction. Turned shafting ground to size is used, heavy duty shafts being of forged alloy steel. The gears are all of steel, either cast or forged, with teeth cut from the solid. The corduroy tractions are of the P. & H. type, having driving and idler sprockets and treads of high carbon special treated steel casting. The link pins are of heat treated alloy steel forgings. The corduroys are of the self cleaning type and are completely accessible for inspection and renewals with a minimum of jacking. The ground bearing pressure is about 10 pounds per square inch.

By means of independent gear drives on each corduroy the following motions may be accomplished: One, high speed forward and reverse on both corduroys; two, low speed forward and reverse on both corduroys; three, high speed forward and reverse on one corduroy and a low speed forward and reverse on the other interchangeably; four, high or low speed forward and reverse on one corduroy with other corduroy running idle, interchangeably. All of these motions are controlled from the operator's platform regardless of the position of the revolving frame. The transmission gears move on spline shafts. This construction prevents the gears from sticking.

A 7¼x9-inch 75 H.P. heavy duty internal combustion motor running at 500 R.P.M. is gear connected to the jack shaft, the connecting gears running in an oil tight case. Outside band clutches connect the engine to the jack shaft and are used for the combined swinging and propelling shaft. Drums are mounted on separate shafts, the digging drum being provided with machine cut grooves.

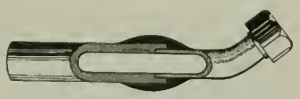
The boom is hoisted and lowered by means of a drum operated by self locking worm and worm gear enclosed and running in oil. Operating levers are concentrated at the front right hand side of the machine, giving the operator full view of the work. The machine is completely enclosed by a sheet steel housing.

PAWLING & HARNISCHFEGER COMPANY'S CORDUROY EXCAVATOR CRANE

CORCORAN WIPE JOINT MACHINE

The Corcoran Wipe Joint Machine, sold by the A. T. Taft Manufacturing Company, has been designed by a water works specialist to fill the needs of municipal water works and master plumbers.

It is claimed to make a better, more uniform pipe joint than is possible by hand, because greater heat is possible,



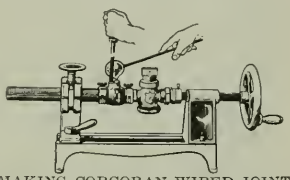
SECTION OF MACHINE MADE CORCORAN WIPED JOINT

and an absolute weld is always obtaintable.

Uniform thickness is also secured with freedom from waste, spoilage and loss of time.

Four wipe joints, each perfect in construction, may be made on this machine with unskilled labor while one is being made by hand.

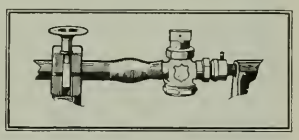
The Corcoran machine is easy to op-



MAKING CORCORAN WIPED JOINT

erate either in the shop or on the job and works equally as well on straight or curved pipe joints and makes a perfect joint in greater strength, uniform thickness and attractive appearance.

Warping, springing and ultimate leakage are eliminated and greater flexibility is secured through a perfect



FINISHED CORCORAN WIPED JOINT

wipe joint than is possible where couplings are employed.

A Corcoran machine joint has strength to resist a 1,000-pound longitudinal pull and an internal water pressure of 750 pounds.

Thousands of wipe joints have been made to date by the water works department of Cleveland with the Corcoran wipe joint machine.

NO. 56-H LITTLE DAVID CLAY DIGGER

Another substitution of mechanical methods for slow and costly manual labor has apparently been made in the case of a new air operated tool that does the work of ordinary hand picks. On many digging jobs in stiff clay and hard soil for trenches, shafts, tunnels, etc.,

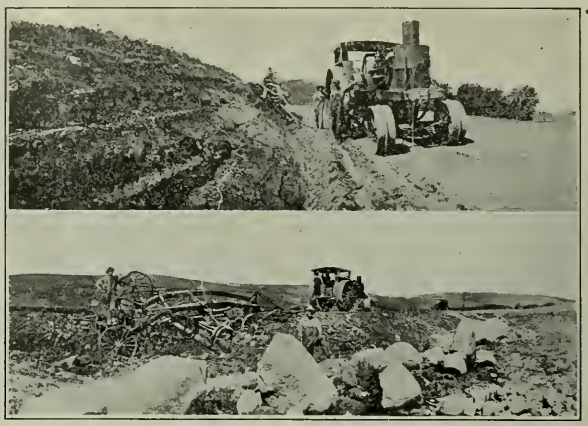
the ground is not hard enough to be drilled and shot and yet it is too hard to be removed with the ordinary hand shovel alone. Where a large power driven machine can not be worked the usual procedure is, of course, to employ men with hand picks to loosen the ground for hand shoveling. This new air tool has been developed to eliminate most of such hand pick work.

Ordinarily one shoveler serves one man with a pick. With one of these pneumatic diggers one man can generally loosen as much ground as five men with hand picks besides maintaining a more uniform rate of work with fewer pauses for rest. One man will loosen enough dirt to keep five shovelers busy all the while. The danger of accident from careless swinging of the hand pick is also eliminated so that the men are able to work close together in a trench or shaft.

The new compressed air operated tool is of fairly light weight (23 pounds complete), which a man operates while standing in an upright position. It is an air hammer, 34 inches in overall length, with a digging blade held in the nozzle end of the hammer. The blows of the hammer drive the blade into the hard ground so that it is pried loose. For clay the 6x8-inch blades are of a slight scoop shape. For earth they have a 5x9-inch rectangular flat face, 5/8 inch thick at the top and 5/16 inch thick at the bottom, with the cutting edge beveled from the back.

The throttle is conveniently located in the grip handle so that the air can be readily shut off as the tool is lifted from one position to another. A buffer is, however, provided inside the retaining nozzle to take the blow if the hammer is operated while the tool is being lifted.

This tool is manufactured by the Ingersoll-Rand Co.



AVERY TRACTOR HAULING ADAMS BLADE GRADER ON DIFFICULT SIDE HILL WORK

SIDE HILL MACHINE TRIMMING

A letter of May 11, from a firm of highway contractors in Britton, South Dakota, says: Regarding the work done by our Avery Tractor on Federal Aid Project No. 41, Marshall and Roberts counties, South Dakota, will say we bought this tractor in 1920. The first year it pulled an elevating grader; the next year, 1921, it pulled a 12-foot Adams blade grader. We find that a wheel tractor, especially an Avery, is well adapted for this purpose as it packs the shoulders of the road so that it becomes almost as hard as a pavement.

The photos show the Avery pulling an Adams blade on a back slope near Sisseton, South Dakota. We finished our back slopes in this way as it proved to be a great deal cheaper that way than any other way we could find. We also used the same machines for sloping the sides of our hills. This has the effect of producing nice, well defined and even shoulder lines, something the State Highway Commission is very insistent upon.

This particular job was the largest job let in South Dakota, being 25 miles long and not one particle of dirt could be cast in but must be hauled. It was all in the hills between Britton, South Dakota, and Sisseton, South Dakota.

INGERSOLL-RAND COMPANY'S LITTLE DAVID CLAY DIGGER IN OPERATION

LITTLE DAVID CLAY DIGGER, EXTENSION HANDLE

BUCYRUS COMPANY

This company has under way at the present time extensive enlargements to both its plants at South Milwaukee, Wisconsin and Evansville, Indiana.

These changes and rearrangements are planned to take care of their increasing volume of business and to enable them to manufacture more economically. In the South Milwaukee plant, where all the larger machinery is built, a new gray iron foundry, 276 feet in length, is now under construction.

The old gray iron foundry is being converted into a cleaning room with annealing ovens, sand blast rooms and a welding room. A large addition is also being made to the steel foundry moulding floor.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 June 17, 1922 No. 24

Construction of Loch Raven Dam*

By Wm. A. Megraw†

Raising a dam fifty-two feet, using concrete chuted to place from one end. Gravity and machinery used in plant with considerable saving in labor. Provision for draining joints and inspecting seepage. Total cost of dam exceeds a million dollars.

Baltimore is engaged in making what is known as the Gunpowder improvement to its water supply. The plans include a dam at Loch Raven, on the Gunpowder river, to impound 23 billion gallons of water, and a balancing reservoir to limit the pressure on a 7-mile tunnel conducting water from the dam to the filter plant, together with the necessary relocation of roads and bridges, the purchase and removal of the villages of Warren and Phoenix, the relocation of 1.5 miles of Pennsylvania Railroad tracks near Phoenix, the purchase of about 4,000 acres of land from 54 different owners, and clearing buildings, trees and vegetable matter from the ground to be flooded.

DESIGN OF THE DAM

The principal feature is the Loch Raven dam, which is nearing completion. Plans for this were first prepared in 1913 and the work completed during the following year to elevation 188 feet above mean tide, the base being made broad enough to support an additional section which it was proposed to add later to raise the dam to elevation 270. The plans under which the present contract is proceeding provide for raising the dam from elevation 188 to elevation 240.

The dam is a solid concrete structure, 640 feet long over all, with a spillway 288 feet long and rising about 103 feet above bed rock.

In designing the cross section, an upward pressure was assumed on all horizontal joints, equal to the full hydrostatic pressure at the upstream face and decreasing to zero at the downstream face. Porous drains in the horizontal joints are provided to relieve this upward pressure. Two 48-inch pipes passing through the old foundations control the ordinary flow of the river and enabled all concrete to be deposited on dry surfaces. One-inch bent steel rods, spaced five feet apart horizontally and vertically, are imbedded three inches back of the down-stream face and can be straightened to assist in binding the new concrete to the old in case the dam is ever raised to a higher elevation.

The gate chamber is divided into two separate compartments, each of which is designed to supply the city separately. Fifteen sluice gates, 3½ feet by 6 feet, arranged at different heights, control the entrance of water.

GENERAL LAYOUT OF WORK AND PLANT

The dam is located between steep hillsides and the available working space is small. Stone was furnished from a city quarry located on the west side of the river 3,000 feet down stream from the dam. An improved highway extends from a point on the hillside opposite and above the dam down to and past the quarry to Loch Raven Station on the Maryland and Pennsylvania Railroad about 2,200 feet further down and about eleven miles from Baltimore. The railroad at Loch Raven Station is approximately at right angles to the river and follows along a steep hillside about 50 feet above the highway, which turns and parallels the railroad in both directions. A siding about 1,600 feet west of the railroad station provides a means of handling materials from the railroad by gravity to the highway below. An old city-owned siding 1.6 miles long is located on the east side of the river and extends from the dam southerly to a point where the railroad, 1.2 miles east of Loch Raven Station, meets it at grade. This arrangement of highways, railroads and sidings, offered several means of handling the work of construction.

The contract was awarded to the Whiting-Turner Construction Company of Baltimore on April 6, 1921, and about July 1, the first concrete was deposited. The bulk of the work was completed by January 1, 1922.

The specifications permitted the use of cyclopean concrete, but the contractor installed a chute system for distribution, which precluded the depositing of large stones, except in the east shore section, where a derrick, used for excavating the east abutment, swung a portion of the larger stones into the dam.

*Paper before the American Water Works Association.
†Water Engineer, Baltimore Water Department.

The chute system was designed by the Lakewood Engineering Company.

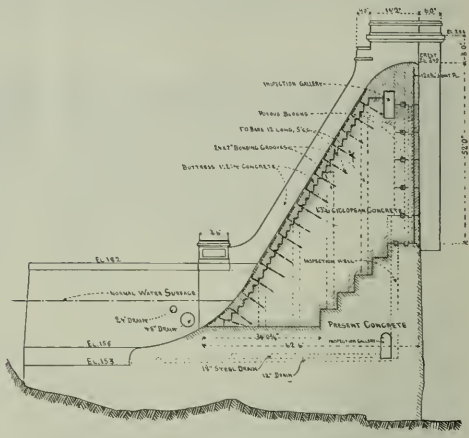
On the west side of the river, the topographical conditions were ideal for a gravity plant. The contractor, availing himself of this advantage, located his crusher, storage bins and mixing and distributing plant up and down the west hillside just south of the site for the dam, although the city siding on the opposite side of the river connected the dam directly with the main line of a railroad.

Cement was the only material hauled by railroad. On the hillside below the siding at Loch Raven Station a cement house was built with a capacity of 5,000 barrels. The cement was here received in bags and handled by a belt conveyor operated by a gasoline engine which also operated a bag shaker consisting of a wire cage rotating about 7 minutes for each charge. By means of a chute the bags of cement were passed to trucks, which transported the cement to a 200-bbl. capacity shed located on the hillside above the plant, whence it was conveyed directly to the mixer platform by chutes.

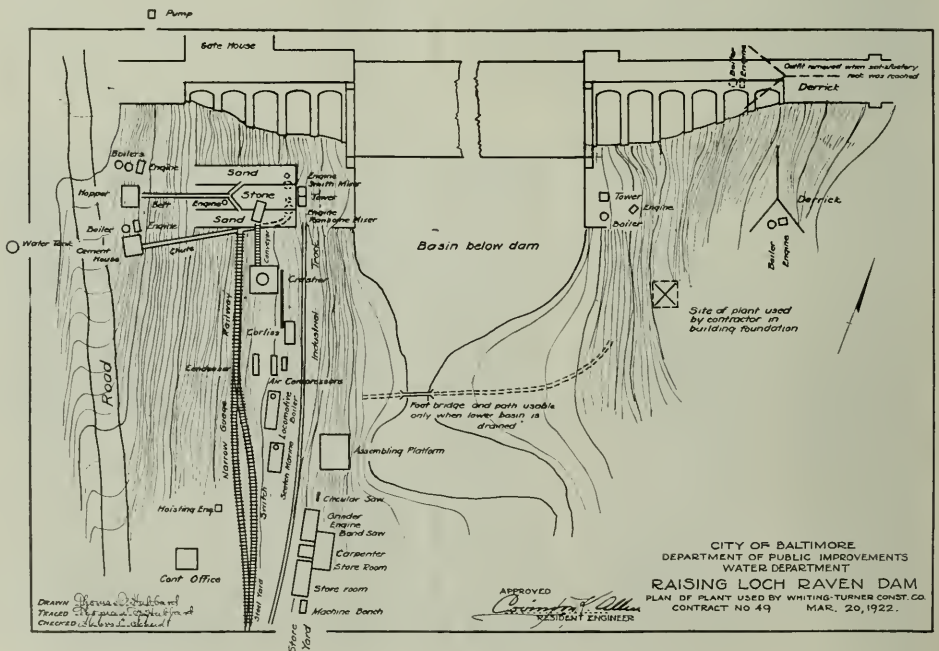
OBTAINING SAND AND STONE

The neighborhood sand is generally not suitable for concrete, but the contractor was able to locate an excellent sand pit about 2 miles from the dam. The cost of this sand at the pit was 24c. per cubic yard and the cost of trucking 44c. per cubic yard, making a total of 68c. for the sand delivered. The quotation for river sand shipped from Baltimore was 70c. per ton plus $1.14 for freight, which is the equivalent of $1.45 per cubic yard. The contractor was thus saved 75c. per yard and the delays consequent to rail shipment. The sand was excavated by a three-quarter yard revolving steam shovel and transported by motor trucks to a point above the plant and dumped directly into a hopper at the elevation of the highway, from which a belt conveyor carried it to two large storage bins, one of which is located on each side of the stone bin. The total capacity of the two bins is 500 cubic yards.

The sand contained a maximum of 10 per cent



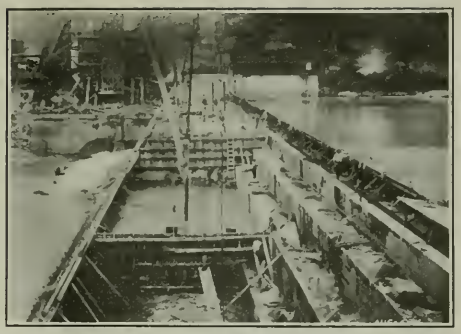
CROSS-SECTION OF LOCH RAVEN DAM



LAYOUT OF CONTRACTOR'S PLANT FOR CONSTRUCTING LOCH RAVEN DAM

of clay, which was twice the amount authorized by the specifications, but it was accepted after thorough tests had been made, one to three mortar briquettes showing an average of 250 pounds per square inch, which is 50 pounds above the standard requirement. At different times, as the work progressed, 4-inch cubes were made from concrete as it passed from the chutes into the dam. The compressive strength of these cubes at the end of 28 days averaged 1,800 pounds for 1-3-6 concrete and 2,200 pounds for 1-2-4 concrete. The sand was well graded from small to large and contained a considerable percentage of gravel for which reduction was made in the stone. The clay seemed to lubricate the concrete, causing it to be more easily mixed, chuted and worked. The concrete produced a smaller amount of laittance than is usual and honeycombing is almost entirely absent from the dam.

The stone was taken from the city quarry with no expense other than that of actual quarrying. For each blast, two large well drillers were used to put down about 10 holes 12 feet apart and 85 feet deep, located parallel to and 20 feet back of the quarry face. Three large blasts, each requiring about 4,200 pounds of dynamite, made at different times as the work progressed, were required to throw down the necessary 45,000 yards of rock. After each shot, considerable secondary drilling was done by various kinds of drills, and tripod and jackhammer, besides a large amount of mud capping, in order to reduce the stone to steam shovel size. The air used by the drills was piped from a power plant located below the dam. A ¾-yard Erie shovel used at the beginning of the job soon proved insufficient and was



CONCRETE BINS, MIXER AND TOWER AT LEFT BACKGROUND; FACE FORMS TEMPORARILY BRACED IN POSITION

replaced by a 90-ton Marion shovel for loading the stone into dump cars.

The cars were hauled a half mile to the dam over a 36-inch gauge track by an 18-ton dinkey, four cars constituting a train. As the track approached the dam, it was elevated on a trestle at 5.8 per cent grade, permitting dumping directly into a 1,500-ton gyratory crusher. A hoisting engine was used to spot the cars up the incline to the front of the crusher, which enabled the locomotive to return for another train while the first trainload was being dumped and crushed. From the crusher the broken stone was raised to an overhead bin by means of a belt conveyor. The stone bin has a capacity of 1,000 cubic yards and is located between the two sand bins.

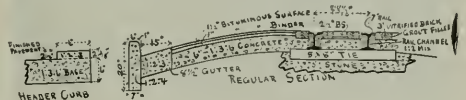
(To be continued)

Dallastown Asphalt-Concrete Highway

Construction of about 1.1 miles of sheet asphalt pavement on cement concrete base with concrete curb and gutter. Details of labor.

Route 216 of the Pennsylvania State Highway System, in York county, is 5,786 feet long and has a uniform concrete base covered with a sheet asphalt wearing surface, the total thickness being 8½ inches. It extends on each side of the street car tracks to a concrete gutter 15 inches wide and 8½ inches thick, which in turn extends to the 7x20-inch concrete curb. The rails and ties are laid on broken stone ballast and the spaces between and on both sides of the 7-inch rails are paved with 3-inch vitrified brick with grout filler. Between the tracks the narrow strip, edged on both sides with paving brick, is finished with 2½-inch thick bituminous surface. The rails are set in 1:2 cement mortar. The maximum grade is 5.69 per cent. and the maximum curveture is 11 degrees 30 minutes.

The contract was awarded to the A. P. Kroft Construction Co., York, Pa., which commenced operations July 25, 1921, and finished the work the same fall. The concrete curb was first laid and was built in accordance with the Pennsylvania State Highway standards, except that the thickness was, by special request of the borough, made 8½ inches instead of the usual 6 inches. It was concreted in 10-foot sections in forms made of 2-inch surface planks. A gang, consisting of one foreman, one mixer operator, 5 skilled laborers and 20 common laborers laid an



TYPICAL CROSS-SECTION OF ROAD

average of 330 feet per 10-hour day and completed 11,570 linear feet in 37 days with the use of one ½-bag concrete mixer and two trucks.

The grading, involving 4,626 yards of excavation, besides that for the track foundations, which was done by the York Railway Co., was commenced August 18 by a Keystone steam shovel with a ½-yard bucket, served by four automobile trucks. The work was done by a force of one foreman, two skilled laborers and twelve common laborers. The subgrade was crowned parallel to the finished surface and was thoroughly compacted by a 10-ton steam roller manufactured by the Harrisburg Foundry Co.

On August 26th the construction of the concrete gutter was commenced which, like the curb, was built in sections 10 feet long, the entire amount of 11,570 linear feet being made in about 42 days by a gang consisting of one skilled laborer, twenty common laborers and a foreman, served by one truck and one ½-bag mixer.

Concreting the base course was commenced September 26th. Header curbing was first placed at all street intersections. Sand was procured locally and from the Arundel Corp., Baltimore. Stone was secured from local dealers and both sand and stone were stored in stock piles where they were loaded by a Jeffrey type K loading machine and by the steam shovel which served a fleet of seven 1½-ton Autocar trucks, in which the aggregate was transported to a Rex mixer and a Koehring mixer, each of two bags capacity. Each truck was divided into two compartments and carried two batches each containing 6 feet of sand and 12 feet of stone. Cement was stacked in piles along the street and dumped by hand into the skips. Concrete was mixed about one minute with from 14 to 20 revolutions of the drum. Each concrete gang consisted of five skilled laborers, ten common laborers, and a foreman. The surface of the concrete was finished to template and left slightly rough, but not open. Construction joints were made at the end of each run by a wooden bulkhead. The total amount of concrete base was 16,842 square yards which was laid with the two machines at an average rate of 1,200 square yards per 10-hour day.

The 1-inch binder course laid on the concrete base was proportioned 4.7 per cent. asphalt cement, 16.6 per cent. sand and 78.7 per cent. stone. The binder was mixed at a plant about 8 miles from the site and the material was hauled to the job by five 5-ton trucks, each carrying an average load of 4.5 tons of hard material at the usual temperature of about 275 degrees Fahrenheit and delivered at the job.

The 1½-inch wearing surface was proportioned 10.4 per cent. asphaltic cement, 11.6 per cent. limestone dust and 78 per cent. sand. Like the binder, it was mixed and heated at the remote plant and delivered by trucks reaching the site at a temperature of about 225 degrees Fahrenheit. The asphalt top courses were finished by an 8-ton Iroquois roller, and a gang of four skilled laborers, three common laborers and one foreman equipped with one wagon and five 5-ton trucks, made an average of 1,500 square yards of pavement per 10-hour day. The work was executed for and under the direction of the Pennsylvania State Highway Commissioner, with assistant engineer G. Van Riper in charge when the work was completed.

Engineers' Plans for State Health Boards*

Regulations of State Boards of Minnesota, Mississippi, Montana, and Nebraska, with respect to the contents and form of plans and reports requested to accompany applications for water and sewerage permits.

Minnesota—Before any plans for water supply, sewerage or refuse disposal are prepared, the State Board of Health should be notified and it will investigate conditions and report to all interested parties as promptly as possible, stating the requirements of the Board for this particular case, which should be observed in preparing the plans. Duplicate copies of plans should be sent to the Board. If they are not found satisfactory the engineer is notified and given an opportunity to change them before the matter is officially reported to the authorities. A municipality should furnish to the Board in writing its authorization of the engineer to submit the plans.

Approval of plans does not include approval of structural features of design, such as thickness of concrete or efficiency of any mechanical equipment. The Board reserves the right to withdraw approval of a system whenever it may be found to be operating unsatisfactorily. Since the safety and sanitary quality of a water supply depend largely upon the construction to prevent contamination, final approval of any water supply cannot be given until after its completion and inspection.

Water Supply.—There is required a map, scale between 100 and 300 feet to the inch, showing source of water supply, pumping stations, reservoirs, filtration plant, and location and size of each main. Plans shall show in detail all new work and connections to existing system, drawn to such a scale as to show clearly all details.

Sewerage—A map showing entire sewerage district, drawn to a scale between 100 and 300 feet to the inch; showing all salient topographic features, and 5-foot contours; also elevations of surface and sewer pipe at street intersections "unless a complete set of profiles is provided." Location of sewage treatment plant and outlet should be shown. Plans shall show clearly all essential details of the design. If the map does not show clearly surface and sewer elevations and grades and sizes of pipe, profiles shall be submitted. Elevations of unusually deep basements shall be shown.

The Board has no jurisdiction over storm sewers.

*Continued from page 427.

The provision as to minimum grades found in the Arkansas rules are given (see page 323), with the additional provision that in no case shall the grades be less than .33 ft. per 100 ft. for 6-inch, 0.25 ft. for 8-inch; 0.23 for 10-inch, etc., down to 0.08 for 24-inch. Engineers are cautioned against "specifying pipes of sizes which are obviously larger than necessary for carrying capacity, but which are used in order to meet grade requirements."

In addition to the above, the instructions of the Board contain rather extensive statements of features of design of both water supply and sewerage systems that must be avoided. These will be published later as a separate article.

Mississippi—The regulations of this Board specify only that there shall be furnished "complete plans and specifications for the installation, together with such information as the State Board of Health may require," submitted in duplicate. "Plans for sewerage systems shall include the sewer system and disposal plant, give information regarding the stream into which the effluent is to be discharged" and provide for the entire community and for its reasonable growth.

Montana—The regulations of this Board are the same as the Arkansas ones with the following exceptions (and a few other minor ones): Maps for sewerage or water works systems may be as small as 600 feet to 1 inch. "A small scale map of the catchment area shall be furnished compiled from actual surveys if such have been made or from maps of the Geological Surveys if such have been extended over the country, otherwise from the best data obtainable. Such map should show the relative locations of towns, villages, mines or other settlements which may affect the sanitary condition of the watershed or the future quality of the water supply." Under the head of "Wells and Collecting Galleries" there is added: "There shall be a map showing the location and extent of the ground that is controlled by the municipality or company making the development and the nearest source or sources of possible certain water shown thereon. Profiles shall have a horizontal scale of 100 ft. to 1 in.

In "Information Concerning Sewer Systems," there is the additional item: "Distance of sewage outlet from shore and depth of water at outlet if outfall discharges into a large stream."

Nebraska—Plans "shall be submitted in the form of blue prints in triplicate, and shall be accompanied by three copies of specifications and three copies of an engineer's report on the subject." There is required, for water works, a map showing principal topographical features, streets, boundary lines of improvement districts, location and size of mains, and other features as specified by the other state boards, to be drawn to a scale of not less than one inch to 300 feet. Also detail drawings of pump houses, treatment plants, wells, intakes, and all appurtenances. In the case of ground water a graphic log of the well to be used or of the test hole, and in the case of surface supply a small scale map of the drainage area. For sewerage systems there are required a map of district to be served, same scale as above, and showing sewers and other features, with contour lines at not more than 5-foot intervals, or 2-foot where grades are light. Also profile and plan of each sewer, showing size, grade, appurtenances, etc. Also detail drawings of all appurtenances.

"The engineer's report shall include a comprehensive statement of the conditions obtaining in the locality of the proposed work," including population, expected growth and all others that have an important bearing on the problem. It shall discuss, for water works, the needs and resources, mineral and sanitary characteristics of the proposed supply and facts and data on which the design is based; for sewerage, ultimate disposal, danger of nuisance, and the facts and data on which the design is based.

Water-Borne Typhoid in Havre

Following serious typhoid epidemics in Havre, France, during recent years, studies of the cause were made by a number of scientists, and one of these, Dr. J. Sanarens, has recently published his conclusions, which contain a number of interesting points. He bases his conclusions very largely upon a sanitary survey of the entire watershed rather than upon merely laboratory tests and conclusions.

Havre's water supply is drawn from a zone of chalk surmounted with a limestone layer which is less fissured, and with diaclase, generally mixed with clay and sand. The waters have their origin in channels or small subterraneous streams. These apparently receive impure, unfiltered water from the surface, especially during periods of heavy rain. In dry periods the waters are remarkably free of micro-organisms, there being few cities in France provided with water as pure bacteriologically. Following heavy rainfalls, however, the water becomes turbid and comparatively high in bacteria, apparently proving pollution by impure ground waters. A study of previous epidemics showed that the curve of cases approximately paralleled that of the annual yield of the source of the water supply as well as that of the temperature of the water and air. The maximum number of cases has always occurred in August and September after the most violent rainfalls of the warm period; while the least typhoid fever occurred after periods without rain. After torrents, the increase of typhoid fever cases generally occurred from 10 to 25 days after the rain, a time which corresponds to the period of incubation of typhoid fever. These observations are based upon the experience of twenty years.

A number of interesting investigations and tests are referred to in the report. In water artificially sown with typhoid bacilli without the presence of the normal saprophytic organisms, the typhoid bacillus, exposed to diffused north light or in the dark, was found to live more than 100 days, when the water was not renewed in the test container and when culture was used containing very little organic matter. This is probably the limit of practical conservation, for after 100 days the cultures were difficult to obtain and often failed to develop. The experiments of Dr. Pottevin show that in calcined sand the bacillus has been able to live for seven months on this support, in a current of Havre limestone waters.

Discussing indol formation, the author points out that he had been able to show by numerous tests that B-coli coming from the human intestine generally gives a very strong reaction with violet-red

coloration deepened by the nitrite-sulphuric acid reagent; but that B-coli from the intestines of herbivorous animals give on the contrary generally a pink-orange coloration.

An unusual method was employed for determining how rapidly surface infiltrations reached the underground water supplies. In order to avoid arousing the water takers' antagonism, only small amounts of fluorescin could be used, and these tests were negative. It was then decided to use brewers' yeast, since experiments had indicated that saccharomyces derevisiae were not normal inhabitants of the water, although very dissimilar yeast-like growths were found. Brewers' yeast thrown on the surface of the ground on various roadways was found in the water from 6 to 48 hours after being so spread, thus indicating that surface water seeps into the underground streams at some points with considerable rapidity.

Odor Elimination, New Bedford Garbage Plant

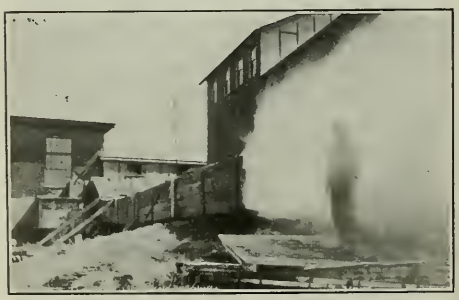
By W. J. Springborn

An installation made by the writer in November, 1921, in the New Bedford, Mass., municipal garbage reduction plant may be of interest to city authorities, not only from the standpoint of the elimination of obnoxious odors, but also because such elimination of odors has made possible a notable increase in the efficiency of the plant.

The Cobwell system of garbage reduction was used at New Bedford, in which the raw garbage is placed in sealed tanks, covered with a solvent (gasoline), and cooked for a period of twelve hours to break down the organic structure and dehydrate the material so that the valuable constituents may be recovered in the form of grease and tankage.

The city of New Bedford had outgrown the capacity of this plant, so that at times it was unable to care for all of the city garbage, even when operating on a twenty-four hour schedule.

At about this time Prof. Yandell Henderson of Yale University, together with his associate, Dr. Howard W. Haggard, made the discovery that obnoxious organic odors could be destroyed by a simple and inexpensive treatment with chlorine gas, and



EXHAUST FROM DIRECT HEAT GARBAGE DRYER AT NEW BEDFORD GARBAGE REDUCTION PLANT

preliminary experiments conducted in a Cleveland plant in co-operation with the writer indicated the process could be installed on a commercial basis.

It has long been known that direct-heat drying of garbage is more economical than cooking, pressing and drying, but this method has not generally been employed because of bad odors generated by the driers. In view of this new deodorizing development, it was decided to install a direct-heat rotary-type drier at New Bedford, for preliminary treatment of the garbage before placing it in the Cobwell reducers, and thus reduce the time required for driving off the moisture and degreasing the material, thereby increasing the capacity of the plant, and to overcome the odors created by the drier by the process developed by Professors Henderson and Haggard.

In this plant a duct carried the vapors from the driers outside the building and discharged them at ground level so that close observation could be had of the odor control. The deodorizing equipment consists of a special type of Wallace & Tiernan control apparatus, through which volatilized gas from liquid chlorine is passed into a mixing chamber, thence into the duct. The velocity of the vapors through the duct is such that about seven seconds of contact between the chlorine and the odor-bearing gases is maintained. Since installation, complete elimination of odors from the drying of garbage has been effected with a chlorine consumption of less than eight pounds per day. During the months of December, 1921, January, February, March and April, 1922, 900 pounds of chlorine gas was used costing seven cents a pound, or $63 as a total cost to deodorize the vapors from 4,098 tons of garbage, an average cost of 1.5 cents per ton of garbage treated.

By using the drier installation it has been possible to increase the capacity of the plant by fifty per cent., the cooking period in the Cobwell machines being reduced from about 12 hours to 3 hours.

Not only has the plant capacity been increased, but economies have been effected in several items of operating cost. The following comparative figures have been given out by C. M. Schindler, superintendent of the plant, covering periods before and after installation of the drier:

Before Drier Installation

December, 1920—January and February, 1921

	Total	Per Ton
Garbage treated	2,433 tons	
Coal	527 gr. tons	485 pounds
Solvent used	29,082 gallons	11.95 gal.
Power and light	$2,114.35	$0.87
Labor costs	$7,473.90	$3.07
Water	$ 30.65	

After Drier Installation

December, 1921—January and February, 1922

	Total	Per Ton
Garbage treated	2,470 tons	
Coal	347 gr. tons	
Coke for drier	188 net tons	475 pounds
Solvent	12,126 gallons	4.9 gal.
Power and light	$1,934.24	$0.75
Labor Costs	$7,292.60	$2.95
Water	$ 25.43	

Fixed charges, such as cost of supervision, depreciation, etc., are not included as they were not affected. The largest saving was in the solvent used, there being a reduction from 11.95 gallons per ton

of garbage treated to 4.9 gallons, due to the reduced cooking period. Future operating costs will show a further reduction in fuel consumed, due to the fact that the second set of figures includes a considerable quantity of fuel burned while the installation was being made to warm the plant. It will be noted that a slightly greater volume of garbage was handled in the second period at a slightly lower labor expenditure, and there is some reduction in the items of power and light and water.

The deodorizing equipment has been put to rather severe tests with entirely satisfactory results. On one occasion we placed in the drier such strongly odorous materials as putrid meats, rags, hair, feathers, etc., and while the deodorizer was in operation no odor issued from the duct. The photograph shows Mr. Schindler standing in the vapor discharge from the drier, there being detectable neither odors nor chlorine. Following success with this installation in reduction plants, a number of installations have been made for the destruction of odors from private rendering plants.

Explosives in Producing Crushed Stone*

It is not the price per pound of the explosive that is so important, but the cost per ton or yard of stone produced; not even the explosive cost per yard of the material as blasted but the final cost on the cars, which includes drilling, blasting, loading, transportation, crushing, overhead and all other operating expenses. Blasting affects every item in the cost analysis and if it is not properly done, the cost of each subsequent operation will be higher than it should be.

Drilling to proper depth is of the greatest importance in a quarry. Holes are not generally drilled deep enough below grade. In order to be sure of the proper depth it is advisable to run a line of levels over the floor and on top of the quarry face, establishing permanent bench marks and setting reference stakes at various stations around the face for the drill man. These stakes should indicate the depth to which the holes should be drilled. This little item alone may be worth a great many dollars to the quarryman in a season.

The use of large diameter cartridges is advisable in loading deep well holes and manufacturers can furnish dynamite in all sizes up to 5" in diameter. Large cartridges lighten the labor of loading and permit a higher concentration or greater bore hole density of the explosive in the bore hole. When large cartridges are used, very little tamping of the explosive, and often none at all, is necessary. Tamping here does not mean stemming. If holes are dry the cartridges should be slit lengthwise two or three times and dropped or lowered into the hole. The fall causes the powder to spill out, practically filling the hole. Slitting the cartridges is not advisable when water is present. Make haste slowly in loading the explosives in quarries, especially in large holes.

Do not hurry the work but furnish enough help on the job so that loading will go on with despatch. Such despatch may often result in saving money, especially if the holes are wet, and besides it means disposing of a rather unpleasant and anxious job quickly. From four to six tons of stone is, as a general rule, considered good for primary shooting in well drill work. If the bottom is heavy or if there is a hard toe, it is best to use a higher strength explosive at that point, loading the upper part of the hole with lower grade.

Do not load holes when too near a steam shovel or locomotive, unless a screen or awning is used to prevent sparks or hot cinders from falling into the hole. There have been some very disastrous accidents from this cause alone in the last year or two.

In well drill work the holes are usually drilled and blasted in singe rows. The question often arises whether it is better to blast two or three rows at a time, the holes arranged in staggered order, or one row. Some experienced men think that better results and greated fragmentation are obtained by blasting two rows at a time. Most quarries, however, use the single row system. I am inclined to believe that the single row is best when the face of stone is 50 feet high or over. Below that height, it depends upon local conditions. The general practice within relatively shallow holes, from 20 feet to 30 feet in depth, is to blast from two to five rows at a time in order to break the stone up well and in greater volume so that the track and shovel movements are kept at a minimum.

When more than one row is carried, the holes in the back row should be loaded at least 10 per cent heavier than those in the front for best results. I believe, also, that the spacing between rows should be less than the distance from the first row to the edge of the face. In high faces, I do not think the double row advisable at all. Often, even in quarries where the face is 50 feet or under, only one row is blasted at a time, but a buffer or blanket of stone is carried; that is, a whole or part of a shovel cut from the previous blast left against the face to be shot.

The idea of the buffer is that it offers greater resistance or confinement to the charge and better fragmentation is gained. It is used in many cases, especially in lower faces, to hold back the material so that the stone is piled up high enough for economical working of a steam shovel and to avoid irregular track and frequent moving of track. I believe in a buffer in the lower faces, especially if a shovel is used for loading. Sometimes, however, too much buffer is used and the stone is not thrown out far enough to permit access for the secondary drilling and blasting. The shovel is consequently often held up until the obstruction is drilled and blasted.

It is often better, especially if the stone lies in heavy ledges and there are open seams, and the tendency is for the ledges to move or slide before the full breaking effect of the explosive is gained, to allow the material to be thrown farther out so that secondary treatment can be carried on before the shovel reaches that point. In higher faces, from 50 to 200 feet, no buffer whatever is used nor is necessary. Each blast is cleaned up before another is thrown down.

* Abstracts from a paper read before the Convention of the National Crushed Stone Association, by S. R. Russell.

There are many quarries where the tripod method of drilling is the most economical. This is apt to be true especially in quarries of low face where the full depth can be carried in one bench. It is a method well suited to quarries where the stratification is irregular or pitching heavily, and where it is impossible to maintain regular benches.

In many of the harder limestone, trap and granite quarries, very economical results are obtained by what is known as the snake hole method. Often a face of rock 50 to 60 feet high can be brought down with a single row of bottom holes which are heavily sprung. This method is commonly used in many of our eastern quarries. The holes are drilled horizontally at the bottom of the face of the rock from 20 to 30 feet in depth and sprung heavily. It is best to start the hole about 3 feet above the floor allowing it to dip so that at the point it is just above or at the level of the floor. It is unwise to start the hole too low. A certain dip must be maintained in order to allow water flow to the drilling surface. Therefore, if the hole is started too low, its point may be several feet below the floor level before springing, and this depth is increased considerably after springing.

Spring holes are usually spaced about 8 feet apart. A strong quick explosive is best suited for springing holes. The first charge should consist of not more than three cartridges of 1¼ x 8-inch dynamite. If there is drill muck or water in the hole this charge will not do much more than clean out the hole and will have a very slight heating effect on the walls of the hole. If the hole is dry, this charge will enlarge it somewhat at the back and heat the walls. In the first case when hole is wet, it is unnecessary to wait longer than one half hour before loading the second charge. If the hole is dry, it is advisableto wait one hour.

The second charge should consist of, say six cartridges and after firing, 1½ hours should be allowed to elapse before loading the third springing charge. Each subsequent springing charge is increased so that the chamber or pocket made by the preceding one is filled, or perhaps it is best to let the explosive rise a few inches more each time until the necessary size chamber is obtained. Compressed air may be blown into the hole after springing. The air, besides blowing out a great deal of pulverized rock, hastens the cooling of the hole, making work safer and quicker.

Many accidents have been caused by loading the final charge of explosive in the bore holes too soon after springing, the charge taking fire from the heat of the hole. It is, therefore, good policy to wait long enough and to be sure that the hole is cool. A rough idea of the temperature can be gained by allowing the tamping stick to stand in the hole about five minutes and then feeling the end of the stick with the hand to find out whether it has become warm. To be absolutely sure, the intervals between charges should be one, two, three, four, five hours after the first, second, third, fourth and fifth charges.

It is seldom necessary to spring more than five times. I would advise waiting after the last springing is done until the following day before loading the holes.

A strong, quick explosive like 50 or 60 per cent Straight N. G. is best for springing in hard rock. For loading the chamber an explosive of lower strength and slower action is best.

For a secondary drilling, rotating hammer drills are most satisfactory and are now generally used. It is good practice to drill the large stone rather than to resort to adobe blasting, or mud capping. It requires about 20 per cent as much dynamite loaded in a block hole to break a stone as it would require to "doby" it. Moreover, an explosive of lower strength than is used for primary shooting can be used for block hole work. Whereas, a strong, quick explosive is required for mud capping, a 20 per cent or 30 per cent ammonia dynamite is advised for block holes in the dolomites or hard limestones, and nothing higher than 40 per cent. for traps or granites.

Mud capping should not be allowed except in emergency, for it is very wasteful. When mud capping is practiced the cost of secondary blasting averages about four tons per pound of explosive, while block hole work the cost runs from 15 to 18 tons per pound of explosive.

Only the best blasting accessories should be used in connection with explosives. Great care should be exercised in testing electric blasting caps and in making connections, the joints being made tight, clean and dry. Only series connections can be made when blasting machines are used as a source of current, because these machines are designed only for series firing, having a low amperage—about 1½—and a voltage sufficient to fire their rated capacity.

It is best to fire big blasts with a power or lighting circuit. Either direct or alternating current of 25 cycles or over will do. It requires 1½ amperes to fire any number of electric blasting caps in series, but this strength of current must be maintained all along the circuit. Therefore, the greater the number of caps in series, the higher the voltage or pressure necessary to hold the current up. 1½ amperes and a voltage equivalent to 1½ times the number of caps in the series should be supplied.

It is better, however, when power is used for firing, to connect electric detonators in parallel or parallel series. When straight parallel is used, which I like best, in well drill work with electric blasting caps, 1½ ampere should be provided for each cap in the circuit. In this case a high amperage but a low voltage is required. In parallel series, at least 1½, and better 2, amperes should be provided for each series.

In priming deep well drill holes, it is advisable to use sufficient detonators distributed along the charge both to assure thorough detonation and to afford a way out in case one should be broken during loading. At least two caps should be loaded in any bore hole, for assurance.

Cordeau-Bickford or detonating fuse is coming into general use for firing large blasts. Cordeau is especially well adapted for well drill hole blasts and is a very safe, sure and efficient detonator. It is besides very easy to manipulate. Cordeau consists of a lead tube about .22 of an inch in diameter, filled with T. N. T. It has a rate of detonation of about 18,000 feet per second and is therefore of great value as a detonator in quickening slow explosives and assuring complete detonation of explosives of low sensitiveness.

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Dam Concrete Plants

The site of a dam, with hills rising at either end and large masses of concrete to be placed in a comparatively limited area, often offers exceptionally favorable opportunity for the use of gravity and stationary machinery in handling concrete aggregates and the finished product, thus eliminating much of the labor needed under other conditions. Several works constructed under this condition have been described in PUBLIC WORKS, and another is described in this issue—the Loch Raven dam.

In this work, rock quarried half a mile from the dam was hauled by dinkie to the dam site and dumped directly into a large crusher, from which the crushed stone was transported directly to the bin by a belt conveyor. Sand brought by motor trucks was dumped directly into a hopper feeding onto a belt conveyor that filled the sand bin. These bins discharged by gravity into the mixers, which in turn discharged into buckets which, raised by engine power in towers, discharged into chutes which reached by gravity all parts of the dam, except the extreme end furthest from the mixer, which was reached by chutes served by a secondary tower.

Thus neither sand, stone nor concrete was handled other than by machinery after being loaded at the quarry and pit, and a much less number of men was required for mixing and placing this 300 to 700 cubic yards a day than is employed for turning out a half or a third of that amount on a pavement construction job.

Adapt the Tool to the Work

The pick and shovel are generally looked upon as the standard hand tools for all excavating except rock; and drills, either hand or power, for rock work of all kinds. But the contractor who is wise is always on the alert to recognize opportunities for adapting other tools or methods to conditions or materials out of the ordinary.

Tough clay is one of the materials that a pick does not serve well for. A number of years ago a laborer on a tunnel being dug through such material sharpened one edge of a steel barrel hoop and, using it like a spoke-shave, gave an idea to his employer which changed the contract from a losing one to a winner. Another method and tool, made possible by the general use of compressed air in tunnels, is described in this week's issue. Another contractor, finding rock in a trench of a shaly nature in thin horizontal layers, instead of drilling and blasting, supplied the men with short bars with flat, wide ends which were driven into the horizontal seams and wedged the rock up in layers at much less cost.

En Route to Normalcy

After sixteen months of practically unchecked decline, from the peak in 1920 until February of this year, building costs have been showing a slight upward trend for the past two or three months. This is natural and in fact fortunate. Had the rapid decline of 1921 continued during 1922, construction costs would have reached pre-war values before the end of this year, bringing disaster to all concerned. There has been an unusual amount of construction work this spring, sufficient to produce a shortage of skilled artisans in most sections and a greater demand for common labor. If such result had not followed the price decline of last year the outlook would have been a serious one, as showing lack of confidence in the future; but the very fact that wages and prices are stiffening slightly is a proof of the general existence of a confidence in the outcome ready to take advantage of more favorable prices.

We anticipate that this slight reaction will be temporary only, and that by fall a further decline will begin, but at a less rapid rate than last year's, to be in turn checked, and that this periodic decline followed by check or slight reaction will continue until prices have returned nearly to those of 1910 to 1914. It is to be hoped that this will occur rather than a sudden collapse of prices, the momentum of which might carry the decline below the pre-war average and involve all in the resulting "hard times."

That prices will ultimately return to normal, or where they would have been had the world war not occurred, is indicated by history. It seemed to many

to be probable that the widespread effects of this latest war so far differentiated it from former ones that the same laws would not apply and the whole world would be changed and would never return to even approximately former conditions. But the four years so far passed seem to show that history is again repeating itself and that the war has caused merely a bump, although a big one, in the curve of industrial progress.

Some manufacturers are still holding up prices to a degree that seems unwarranted, and the lagging in their decline should be hastened in some way, for the good of the public works depending on them. For instance, in 1914, pig iron was $12.40 per ton and cast iron pipe was then $20 a ton. Now, with pig iron at about $20, cast iron pipe is about $45; a difference of $25 a ton to cover manufacture, freight, etc., as compared to $7.60 eight years ago, or more than three times as great, although both labor and freight are considerably less than twice as high. Or, expressed as percentage, cast iron pipe in 1914 cost about 60 per cent more than pig, while now it costs about 125 per cent more. And there are other materials that show a similar hesitancy to keep step with the procession in the return to normalcy.

Road Construction in the Movies

One of the late "releases" is that made by the Department of Agriculture, and shows in several films of moving pictures the various stages of construction of the three most common types of pavement—asphalt, brick and concrete.

As an illustration of how the subjects are treated, the brick picture shows the mining, grinding and mixing of the clay or shale; the cutting, burning, sorting and testing of the brick; and finally several methods of laying brick pavements—on natural soil, concrete with sand cushion, monolithic, etc., and with cement filler and bituminous filler.

By means of these pictures the general public, through farmers' granges, civic associations, and the like, will undoubtedly learn much about modern highway construction.

Health Value of City Zoning*

The movement for the zoning of American cities has made such speedy progress since the districting of New York City in 1916 that, at the present time, more than forty cities have zoning ordinances in effect, while scores of other cities are engaged in various stages of the preparation of zone plans. * * *

In but few American cities has there been an adequate study co-ordinating the various factors of the city plan. The arrangement of railway terminals, the location of thoroughfares, the needs of local transportation and the requirements for recreation space have been all too often either entirely neglected or given consideration as separate problems of city growth, rather than as co-ordinated features of the comprehensive city plan. Still less has there been conviction that the use and arrangement of private property in the interest of the whole community was a necessity. * * *

Two essential principles for reguluating city growth are embodied in zoning ordinances:

First—The division of the entire area of the city into districts or zones, classified according to the predominant uses of buildings into three main divisions, residential, business and industrial.

Second—The regulation of the height and volume of buildings, the amount and distribution of space to be kept open around them and, in the case of dwellings, the number of persons or families who may live in them, all in conformity to a graded scale of intensity, so that more light and air is secured in the outlying districts, where land values are low, than in congested quarters where land is expensive

The setting apart of zones or districts for the various classes of uses to which buildings are put has health significance in respect to the avoidance of major and minor nuisance conditions about the home, and the decrease of overcrowding on transportation system by locating home in districts within walking distances of working places. * * *

Since zoning laws are not retroactive, they will not, for a long period of years, afford relief from present nuisance conditions, but will prevent the entrance of nuisance producing industries into existing and newly occupied residence neighborhoods. * * *

Among the conditions prescribed for housing projects to receive government aid in England has been a limitation allowing eight families per acre for suburban conditions, and twelve, sixteen and twenty-four families for urban. * * *

Up to 1922 the regulation of intensity of development in the United States has been brought about only through such indirect methods as prescribing the percentage of lot area which a dwelling could cover, and the sizes of yards and courts to be left open. The zoning ordinance of Newark, N. J., effective January 3, 1920, introduced here provisions for direct control of overcrowding on the land. The standard set in that ordinance was 25, 105 and 10 families per acre. * * *

Later ordinances show an actual limitation of intensity of occupation, as, for example, that proposed for Cleveland, Ohio, where unit areas varying from 312 square feet to 5,000 square feet (including half the street and alley widths) are allotted to one family. * * *

The zoning of cities translated into health value would mean:

1. Less discomfort from smoke, odors, noise, dust and flies, and, therefore, to some extent greater vitality and better health.

2. Less crowding of public conveyances and so less contact infection.

3. Less darkness and better air circulation on the street surface, with fewer live pathogenic bacteria in street dust.

4. Less shadow on the dark side of buildings and in the spaces about buildings, which means more light and improved ventilation in rooms.

5. More cheerful outlook from the home and greater cheer within. * * *

* Excerpt of an address by Charles B. Ball, Chief Sanitary Inapector, Department of Health, Chicago.

Excavating Tunnel Clay with Pneumatic Tools

Information concerning the use of such tools in excavating hard clay, particularly in tunnels, given in response to an inquiry on the subject

Public Works:—

Dear Sirs—If possible I would like some information on sewer tunnelling using air hammer equipped with a special tool similar to small spade. I want to know the approximate cost per cu. yd. with this method. Also on how small a tunnel this method would be profitable. Also the size air hammer used and the design of the spades used with the air hammer.

Quite some time ago I read about this method being used in Chicago and Detroit, but the articles were indefinite, not giving any details.

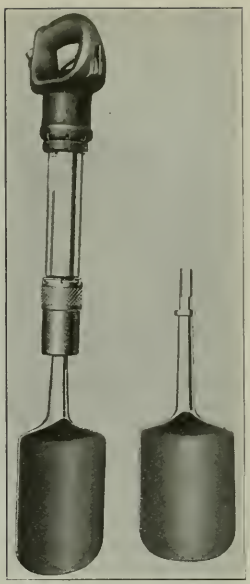
—

The use of pneumatic tools for excavating hard clay, particularly in tunnel headings, is rapidly becoming very popular and has proved convenient, efficient, safe and economical

Special tools are provided by the pneumatic tool makers and air compressor manufacturers that can now be purchased as standard equipment and have given excellent satisfaction.

In some cases pneumatic coal picks have been used to penetrate hard strata and provide for the insertion of bars by which the material can be pried off in chunks. In other cases the clay is excavated without boring or drilling by means of a small spade-shaped tool such as is referred to in your inquiry, which is driven, similarly to a pneumatic hammer, by a small pneumatic piston that causes it to strike rapid blows and cuts through very stiff material.

As both of these tools are easily portable, light appliances of small dimensions and readily handled by a single man, they can be used to advantage in any tunnel, heading or drift or in



LITTLE DAVID PNEUMATIC HAMMER AND SCOOP

EXCAVATING HARD CLAY IN HEADING WITH PNEUMATIC COAL PICKS WITHOUT THE USE OF EXPLOSIVES MILWAUKEE WATER WORKS TUNNEL

pits or trench work where there is room enough for a man to work and even where there is not sufficient clearance for him to use an ordinary shovel or spade.

In the Detroit district the soil tunnelled through varies greatly, from a very soft pumice-like clay to very hard clay. In one section medium hard clay is found full of sand pockets and ordinary hand excavation requires great care on account of the danger of falling roof, and work executed with monkey holes and power or hand knife was hazardous and required constant attention to timbering and sheeting. In this case the use of the pneumatic clay digger enabled the miner to feel his way along and timber in advance of dangerous conditions.

A 10½-foot diameter sewer is now being built in tunnel within a mile of the above mentionel locality and is being excavated through clay so hard that no other method of removal has been found as satisfactory as the pneumatic diggers, one of which is supplied to each of six men in the heading and produces a total output of about 66 cubic yards per day with a maximum of 16 yards per day against the previous maximum of 6 yards per man per day before the pneumatic spades were installed.

These results are so satisfactory that a number of other contractors in the vicinity that had been working nearby for more than a year and distrusted the pneumatic diggers, have become converted and have now purchased them and find that by their use the cost of excavation has been reduced at least 40 per cent.

The spade-shaped pneumatic diggers manufactured by the Ingersoll-Rand Co., are 34 inches long overall, weigh 27 pounds, have a cylinder bore of 1¼ inches and a 3½-inch stroke. They consume from 22 to 38 cubic feet of air per minute at a pressure of from 60 to 100 pounds and make about 750 strokes per minute.

The amount of air consumed is about equivalent to that required for a riveting hammer and is somewhat less than is necessary for the operation of a Jackhammer drill. They can be operated by any adequate supply of compressed air.

A recently completed section of the Linwood avenue water supply tunnel in Milwaukee was excavated with a full size semi-circular top heading 11½ feet in diameter. This was driven through hard, stony clay with pockets and strata of waterbearing sand, quicksand and gravel, in wavy strata substantially horizontal. The clay was found to be frequently stratified with alternating seams ½ inch to 3 inches thick, filled with waterbearing sand and having occasional pockets of sand and gravel.

In the face of the heading inclined holes were driven close together by three Kellar and Ingersoll-Rand pneumatic coal picks, as indicated by the accompanying illustration. Afterwards steel bars inserted in these holes were used to pry off solid chunks of the clay, which were thus removed without blasting or laborious cutting. The heading was excavated at the rate of 10 to 12 linear feet daily and the bench was excavated in the same manner, except that the holes were driven in vertical planes. The excavated material was shoveled by hand to dump cars hauled by mules. As fast as the heading was advanced the roof and side walls were supported by a segmental lining outside of the final concrete lining, which was composed of three-inch planks set on 4 x 6-inch longitudinal sills. This tunnel was driven and the concrete lining placed for a unit price of about $67 per linear foot of completed tunnel. Its construction was illustrated and described on page 407 of Public Works, November 26, 1921.

Take Advantage of the Coal Strike

The following notice has been sent by Frank F. Rogers, State Highway Commissioner of Michigan, to call to the attention of "all contractors who have been awarded or will be awarded state road contracts" the desirability of taking immediate advantage of the surplus of open-top cars caused by the coal strike. Similar notices have been sent to the members of the Southern Pine Association and other wholesalers of building materials. All such, as well as engineers in charge of construction work, should give this matter their serious attention at once.

"The coal strike has had a noticeable effect upon the supply of freight cars, particularly in respect to the open-top cars, the surplus of open-top cars having increased materially during the past two months.

"It is safe to assume that this increase has been largely due to the coal strike and that as soon as the strike is settled the surplus will be rapidly depleted as the cars will be returned for the hauling of coal; and it is not improbable, considering these facts in addition to the large volume of construction work under way, that there may be a car shortage later in the season.

"We therefore consider that it would be excellent policy for contractors to take advantage of the present surplus of cars and stock materials as rapidly as possible so that there may be no possibility of a let-up in construction operations later in the season.

"We also believe it would be advisable to stock cement as a further continuation of the coal strike may deplete the present stocks of cement, and the settling of the coal strike with the revival of business thereby, may cause a really serious car shortage. We therefore believe that the expense which would be necessary for the adequate storage of cement would be entirely justified under present conditions. We feel that contractors can particularly afford this expense this year in view of the fact that they do not have any money tied up in cement on paving jobs as the cement is furnished under state contract.

"We therefore trust that you will consider this matter very carefully and place immediate orders for as large a volume of shipped-in materials as you can handle on your jobs.

"I also think it advisable for you to keep the stock of materials in reserve until the amount of such material is just sufficient to complete the work, and use current shipments for current operations rather than stock some materials and begin immediately to use such materials in the construction.

"The Department will co-operate with you in every possible way to further the rapid completion of your contracts and we will be pleased to confer with you relative to any of your particular problems along this line."

Construction in May

According to the F. W. Dodge Co.'s review of building construction in the northeastern states for May, the total was $362,590,000 which was 50 per cent. greater than for the corresponding month last year and 3 per cent. greater than for April.

From January 1st to June 1st the total is $1,352,965,000, being 61 per cent. ahead of last year, and the highest record for the first five months of any year. The maximum figure was for the central west, $103,533,000, and the report for New York State and Northern New Jersey was $88,295,000 which is 53 per cent. higher than for May of last year, but 13 per cent. lower than for last April.

Stone Slab Roadway in China

The illustration shows a highway in China constructed of heavy stone slabs nearly six feet long used for the comparatively light loads drawn by coolies in two-wheeled vehicles or carried by them as shown in the illustration. Under such traffic the road should, it would seem, last as long as the Chinese wall. This road is on Hanam island, opposite the city of Canton.

For the photograph we are indebted to Prof. M. M. Skinner, who is spending two years in China developing a school for commerce at the Canton Christian College and who is foreign commercial adviser of China.

STONE SLAB HIGHWAY IN CHINA

Concrete Plant for Springfield Bridge

Aggregate for 54,000 yards of concrete dumped from High Street Railway Trestle to storage piles and derricked to mixer bins. Concrete mixed at central plant, hauled by locomotives on low-level service track full length of bridge, hoisted in floating tower and spouted to forms.

The 1,494-foot highway bridge, now being built by the Commissioners of Hampden County across the Connecticut river from Springfield to West Springfield, of which Fay, Spofford & Thorndike are engineers, has already been described in the issue of PUBLIC WORKS for May 20, and the construction of the piers and abutments in the issue for June 10. This article describes the concrete plant used by the principal contractor, H. P. Converse & Co.

MATERIALS

The 100,000 barrels of Portland cement obtained from Hudson, N. Y., and from eastern Pennsylvania, are delivered by rail and hauled by motor truck to the contractor's main yard at the West Springfield end of the bridge and stored in a shed of 12,000 barrels capacity. The total amount is equivalent to 425 carloads, of which the maximum amount used is about three carloads per day.

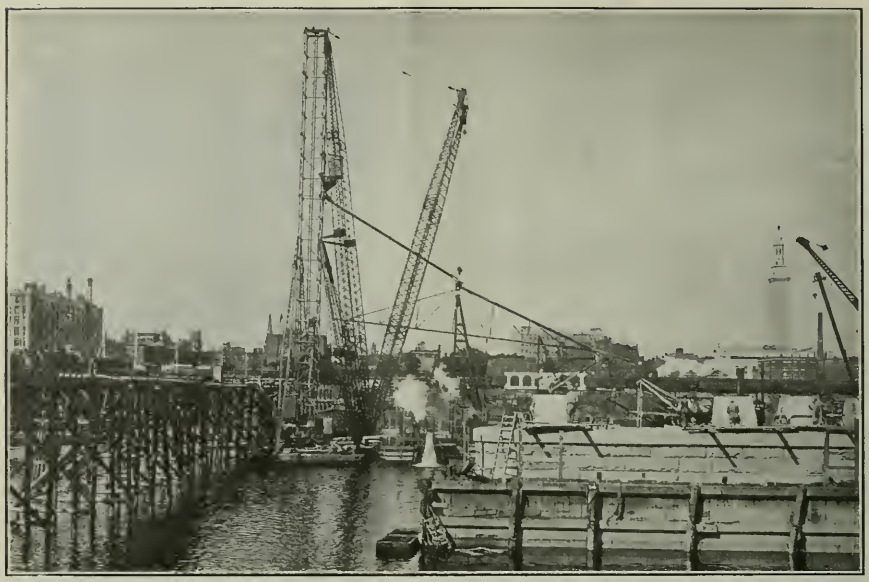
The 73,00 tons of broken stone, equivalent to 2,430 carloads, making a single railroad train twenty miles in length, is furnished by the Holyoke Street Railway Co. from the Mt. Tom, Holyoke, and Lane Notch, Amherst, quarries. The same company also furnishes the greater part of the 30,000 yards, or 1,350 carloads of sand from the company's sand pit between South Hadley and Granby.

Stone and sand are delivered by dump cars on a curved trestle about 15 feet above the surface of the ground for a length of about 300 feet. The concave side of the trestle is faced with horizontal planks forming the side of a storage bin having a maximum capacity of about 1,300 yards of sand and 2,500 yards of stone deposited in the shape of a segment of a circular bank concentric with a stiff-leg derrick having an 80-foot boom equipped with a one-yard clam shell bucket that supplies the 100-yard hopper-bottom storage bin on the top of the mixing tower, adjacent to the cement shed.

A sand and gravel screening plant with a capacity of 400 yards per day has been provided by the contractor to supplement the pit sand and last season furnished 7,300 yards of sand and 9,000 yards of gravel, at estimated costs of about $.80 and $1.60 per yard, respectively.

MIXING AND DISTRIBUTING PLANT

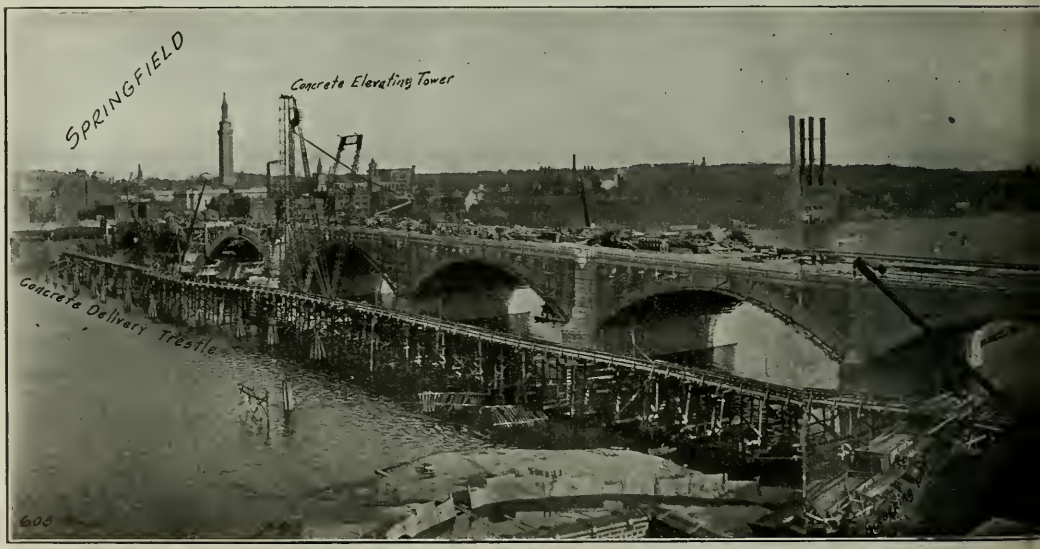
The concrete is all mixed in a 3/4-yard Smith mixer installed under the bins and discharging directly into special two-batch (50-foot) steel cars hauled in two-car or three-car trains by Cummings' gasoline locomotives operating on a narrow gage service line 1,000 feet long carried on an upstream pile trestle parallel to the bridge and about 70 feet



FLOATING DERRICK AND HOISTING TOWER MOORED BETWEEN SERVICE TRACK AND BRIDGE

distant in the clear from it to provide passage between the bridge and the trestle for the contractor's floating elevating tower.

The concrete cars have hopper-bottom bodies with cylindrical side gates operated by hand levers. Each is furnished with a short chute that delivers the concrete to the hoisting tower for the river spans. This steel tower is 130 feet high and is installed on a 36x 75 foot barge, seven feet deep. The top is braced by two stiff legs that may later serve also for steel booms 100 feet long. The tower is intermediately braced by four smaller inclined struts and is equipped with a bucket of 27-cubic feet capacity that is hoisted at a speed of 180 feet per minute by the hoisting en-



GENERAL VIEW OF INSTALLATION OF PLANT AND EQUIPMENT

gine. The hoisting buckets empty automatically into a vertically movable receiving hopper that supplies a three-section steel chute of the Insley type that is supported by shear legs and commands an area of about 100-foot width, that serves to deliver concrete to any part of the adjacent pier, arch rib, or superstructure. For the floor construction some of the concrete was spouted to a movable elevated hopper supplying hand carts at floor level.

The hoisting tower can be shifted conveniently from pier to pier and from span to span as the work progresses, forming a very flexible connection between the mixing plant and the concrete forms and is considered more convenient, economical and rapid than a cableway or industrial track.

An average force of about 30 men was required to trim the stock piles, operate the reclaiming derrick and the concrete mixer, handle cement, run the concrete train and hoisting tower, operate the spouting system and to level and spade the concrete. The best record for mixing and placing is 450 yards of concrete in a 16-hour run and the maximum monthly product is about 8,450 yards. When concreting was suspended, November 26, on account of cold weather, the total amount of concrete that had been mixed and poured was about 49,400 yards, 5,765 yards of which had been placed in the arch ribs of seven spans.

Sand-Clay, Gravel and Top Soil Roads

North Carolina has large mileages of clay and gravel roads, which now demand some form of treatment to protect them from the disintegrating effect of modern traffic and the elements. The State Highway Department has found that a material light enough to penetrate the sand-clay, top soil or gravel surface does not have binding quality; and on the other hand that a material which did have sufficient binding quality was too heavy to penetrate the road. In the case of the heavy treatment, the bituminous material went into the formation of a mat on the surface of the road, and the bond between the road and the bituminous mat was eventually destroyed by the dusting up of the surface beneath the mat. The weakness in this treatment was not in the bituminous blanket but in the contact between the bituminous blanket and the road surface.

Undoubtedly this has been the experience of many of the other states having large mileages of these types of roads, and the experiment being conducted by North Carolina will be of interest and value.

The sand-clay, top soil or gravel surface is first softened by sprinkling, and then a single layer of broken stone or gravel approximately 1½ inches in size is rolled into the surface. After giving the surface time to dry out, and in order to secure maximum consolidation, the roadway is opened to traffic for a short period, after which it is swept clean by brooming.

The road then presents an ideal surface for treatment with an asphaltic material, one to which a material possessing the desirable binding qualities may be applied without danger of being separated from the road surface by the dusting up of the surface as a result of the impact of traffic.

The North Carolina State Highway Department has been using Texaco No. 55 Road Oil in its experiments, and while the new construction has not been subjected to traffic long enough to say that it has proven absolutely satisfactory, it is anticipated that the result will be a waterproof, durable and resilient mat which will add considerably to the efficiency and life of sand-clay, top soil and gravel roads.

CONSTRUCTION OF SPRINGFIELD-WEST SPRINGFIELD BRIDGE

NEWS OF THE SOCIETIES

CALENDAR

June 19—AMERICAN CONSTRUCTION COUNCIL. Organizing meeting. Washington, D. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 20-23—SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. University of Illinois.

June 21-22—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention. Crookston, Minn.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

July 12-14—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Exhibition. Auditorium Bldg., Springfield, Mass.

Aug. 15-18—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 1-6—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-13—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

At the annual convention to be held at the University of Illinois June 20 23, prominence will be given to a discussion of the importance of a study of the English language in the regular engineering courses, to the broader aspects of engineering education and to graduate work in physics.

The College of Engineering will be opened to the convention, various inspection trips to engineering projects and interesting points have been planned and there will be an annual dinner June 21 and a smoker June 22.

RENSSELAER POLYTECHNIC ASSOCIATION

At the regular monthly dinner meeting in New York June 5 the guest of honor was Dr. J. A. L. Waddell, consulting engineer of New York and Kansas City who had just returned from more than a year's absence in Asia and Europe and described some important engineering work he had investigated there, especially the great proposed Yellow River Government Bridge for which a large number of competitor designs were submitted to the international commission of bridge experts, which he headed. Dr. Waddell considered the best of these designs far inferior to American up-to-date practice and opposed the award of a contract to any one of them. He mentioned various other important bridge and railroad projects in China and Hindostan and described some of the difficult conditions encountered by the commission.

AMERICAN ASSOCIATION OF ENGINEERS

At the eighth annual convention in Salt Lake City, Utah, June 5-7 the important feature was the attention devoted to the importance of publicity for general educational advance and for improving politics. The necessity for perfection of publicity machinery was emphasized and improvement and extension of the employment service of the association was provided for.

The officers elected for the coming year are: president, A. N. Johnson; vice-presidents, G. E. Taylor and A. M. Knowles; directors, B. W. Matteson, W. S. Boyle, W. N. Peyton and C. A. Poole.

INSTITUTE OF AMERICAN ARCHITECTS

The 51st annual convention was opened in Chicago June 7. Prominence was given to the desperate labor conditions and unsatisfactory industrial relations prevailing in Chicago which have made building costs there almost prohibitive. The difficulty was illustrated by the fact that 600 guards are required to protect 12,000 imported mechanics and that 1,000 more policemen and 6 more judges have been provided for.

The subject of jurisdictional awards in building construction was discussed and 90% of the delay in building jobs was attributed to jurisdictional disagreements.

The American Institute of Architects unanimously voted alignment with the American Construction Council.

DETROIT BUILDING SHOW

The first Detroit annual Better Homes and Building Exposition May 20-28 was participated in by more than 200 exhibitors and featured the displays of the city plan commission architects and construction organizations.

LOUISIANA ENGINEERING SOCIETY

The technical exercises of the June meeting consisted of an address on "Radio" by Dr. Daniel S. Elliott, Professor of Physics at Tulane University.

AMERICAN FEDERATION OF LABOR

The convention of the building trades department was opened in Cincinnati June 7 and the president was in favor of the proposed national construction council to be composed of the ten principal elements of industry including as units, materialmen, architects, financiers, contractors, engineers, public utility officers, public officers and labor. It was stated that there is a pronounced desire among building labor for co-ordination of the units and a belief that it would bring peace over a greater portion of the year.

President Gompers is reported to have severely criticised the U. S. Supreme Court and to have recommended labor organizations to avoid recourse to courts excepting when compelled to appear as defendants.

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

At the 14th semi-annual meeting to be held at Niagara Falls, Ont., June 19-21 there will be presented various technical papers. The business session of June 20th will be held on board the steamer en route to Toronto, where various plants will be visited. On June 21st, there will be a technical meeting at the Hotel Lafayette, Buffalo, with excursions to industrial plants in the afternoon.

LUMBERMEN'S CONVENTION

The inter-association convention of the Ohio and Northeast Lumber Associations will be held on the steamer Moronic June 16-23, which will cruise from Toledo, Ohio, to Duluth.

BUILDING CONTRACTORS

The executive committee of the Association of Building Contractors for the Third District of Illinois met at Quincy May 25th and discussed the skilled labor shortage and apprenticeship situation on which final action was deferred until the next meeting. The legislative committee outlined a course to deal with the mechanics lien law and the plumbers' license enactment. Governor Allen discussed "Industrial Relations Court in Kansas" and stated that "when an essential industry is in controversy that threatens the cessation to the detriment of public welfare the court of industrial relations may take charge of the controversy and find a decision as to wages and working conditions which shall be just and equitable. The law holds that the right to work is just as sacred as the right to loaf and that it is the duty of government to protect men in their natural inclinations on this subject."—The law holds that "there shall be no conspiracy either on the part of the laboring men nor of the operators to close down as essential industry"—essential industries may close for seasonal purposes but are forbidden to shut down for the purpose of effecting a wage controversy and are not allowed to lock out or to blacklist.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

PORTABLE MACHINERY FOR ROAD BUILDING

A simple and efficient equipment for handling concrete materials in road building has recently been put on the market by the Portable Machinery Company, and consists for a single unit of a contractor's type scoop conveyor, which is designed to handle abrasive materials, a portable measuring hopper and an auto dump truck which, it is claimed, will completely serve the mixer or paving machine and eliminate ten or twelve men of the usual shovel and wheel-barrow gang.

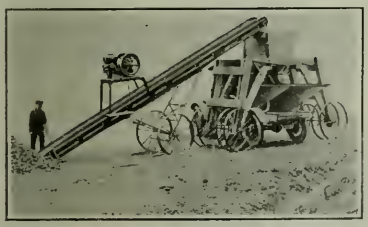
For a small job a single unit will suffice, and the sand and stone piles should be close together along the roadway, near the mixer, so that both may be fed to the same conveyor. One man can feed a specified number of shovels full of sand and the required amount of cement to the conveyor and another man can continuously deliver stone to it until the measuring hopper is full. The contents of the hopper are then discharged into the dumping truck and the latter delivers its load to the mixer and returns for another which is ready for it by the time the truck arrives, thus eliminating all waiting time for loading or unloading the truck or filling the hopper.

For larger jobs it is desirable to use two or more conveyors, hoppers and trucks according to the size of the work and the size of the mixer and the rapidity of its operation.

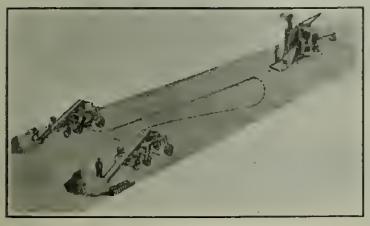
The ideal outfit is two conveyors, two mixer hoppers and two auto dump trucks to provide a reserve in case of any delay for one part of one unit, and makes it possible for one of the conveyors to handle stone or sand from railroad cars or from storage piles to trucks that distribute these materials along the roadway.

In the diagramatic view, one conveyor and measuring hopper handles the stone which is delivered to a truck that is afterwards driven to the sand and cement hopper and receives the remainder of the materials for one batch which it transfers to the mixer and returns for another load.

The measuring hoppers are made adjustable to provide for different proportions of aggregate and, like the conveyors, are mounted on wheels, so as to be easily movable and keep pace with storage distribution of aggregate.



PORTABLE MACHINERY COMPANY'S CONVEYOR DELIVERING AGGREGATE TO MEASURING AND LOADING HOPPER.



IDEAL ARRANGEMENT OF TWO CONVEYORS AND TWO MEASURING HOPPERS SERVING DUMP TRUCKS DELIVERING TO PAVER.

THE SULLIVAN SPADER

The Compressed Air Spader, or Pneumatic Clay Digging Tool, Class "DE-361," manufactured by the Sullivan Machinery Co., consists of a light Sullivan air hammer, weighing only 16 lbs., with a length of 17 inches, and requiring ½-inch air hose. It is equipped with a steel spade and special retaining ring or bushing of the Bronson pattern.

SULLIVAN COMPRESSED AIR SPADER.

This spade takes the place of the hand pick, as well as of the hand spade or shovel in excavating stiff clay in trenches, open cuts, caissons and tunnels in which the ground is not sufficiently hard to be drilled and shot, and yet is too hard to be handled readily by the ordinary pick-and-shovel method.

In tunneling in blue glacial clay, very hard and dry, in the Chicago district, compressed air spades increased the output per miner from 3 to 4 cubic yards per eight-hour shift, to from 8 to 10 cubic yards.

The Sullivan Spader consists of a cylinder, provided at the rear end with a handle secured to it by side rods, and at the other with a special retainer for holding the steel spade in the nose or chuck of the hammer. The hammer or piston runs up inside the hollow, cylindrical valve itself, thus providing a long stroke without excessive length of tool, or undue waste. The drill is operated by pressure on a trigger or thumb throttle placed at the top of the handle grip where its action will not be hindered by an accumulation of mud or grit.

The Spader strikes a hard, snappy blow, giving abundant power for the work to be done, and satisfactory work can be accomplished at any air pressure from 45 lbs. to 100 lbs., although the higher range of pressure is strongly recommended, particularly for stiff ground.

The smoothness of operation of the "DE-361" Spader, its excellent balance, and its freedom from vibration, make it a particularly easy machine to handle, and reduce the element of fatigue for the operator.

It is claimed for the Sullivan Spader that it consumes but little air power per unit of work accomplished, and that this efficiency is maintained after long service; that its smooth operation eliminates undue fatigue, and that it will perform a full day's work over long periods without break-down or necessity for repairs.

CHAMPION PRESSURE HEATING DISTRIBUTORS

The Champion Distributors, made by the Good Roads Machinery Company for mounting on motor trucks, are designed for applying road oils, tar products and dust laying materials.

The distributor unit consists of an encased tank, a battery of burners, a series of pipes, a distributing manifold and a pump which is driven by a power take-off shaft of the motor transmission, and is located directly in the discharge line from the tank.

The standard distributing manifold 8

feet in width, is made in two 4 foot sections so that the material can be applied in varying widths as desired, but it can be furnished any length that may be required up to 16 feet. The manifold is suspended by means of swivel joints so that it can be swung and carried away from the road when not in actual use.

There are only four valves to be operated in the entire piping system. The pipes through which the materials flow from the tank are exceptionally short and are enclosed, thus preventing the material from cooling after it has been properly heated.

Union connections and removable plugs are provided so that any part may be easily detached for cleaning purposes.

Two sets of 12 distributing nozzles are furnished, one of 3/8-inch and the other 1/2-inch diameter in the discharge opening. The nozzles are so designed and spaced that fan shaped streams overlapping each other deliver on the roadway a solid sheet of material the entire width of the manifold.

The centrifugal pump is installed in a heated compartment and is driven by chain and sprockets from the power take-off of the automobile motor transmission. A large pressure regulating valve is installed in a by-pass line around the pump. A pressure gauge located close to the by-pass valve in the discharge line of the pump shows the exact pressure being maintained.

The material can be pumped from the hauling tank or tank car into the distributing tank or transferred from tank cars to storage tanks.

The heating device consists of a number of powerful specially designed oil burners which will increase the heat of a full tank load of material from 225 to 350 degrees F. in 1½ hours.

The fuel is kerosene atomized by air pressure and is carried in a twenty-gallon tank. A small air pump operated by hand maintains pressure in the fuel tank. Thirty-five pounds is the normal pressure to be maintained, while fifty pounds is the maximum pressure.

The tank used with the Champion Distributor is of steel completely jacketed. A large number of flues extend upward diagonally through the tank.

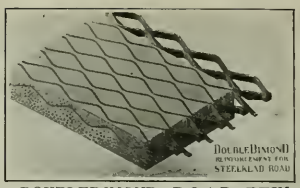
A dome is placed on top of the tank in the center to facilitate loading. Suspended below the base of the dome is a basket-wire screen designed to prevent sticks, debris and other foreign matter from getting into the tank.

The Champion Heating Distributor will handle all kinds of road oils. The lighter oils up to No. 6 when the temperature registers from 70 to 80 degrees can be transferred from tank cars to storage tanks by means of the pump without the necessity of heating the material. No. 6 or lighter oils can be heated from 80 to 150 degrees in from ten to fifteen minutes depending upon the number of unit burners used. In handling heavy oils, should the material be heated initially in the tank car to 225 degrees and then at that temperature be transferred to the tank on the motor, the temperature of the material can be increased at the rate of one and one-half degrees per minute to 350 degrees by the application of heat from the oil burners. Under these conditions, the distributor will easily handle any of the standard road materials.

By varying the speed of the motor truck and the size of the distributing nozzles in the manifold the quantity of material to be distributed may be regulated from one-half to two or more gallons per square yard of roadway.

DOUBLEDIMOND REINFORCEMENT FOR ROADS

This product, manufactured by the Ravenna Steel Co., is a reticulated fabric produced in steel sheets that



DOUBLEDIMOND ROAD REINFORCEMENT.

have a mesh similar to that of expanded metal consisting of parallelograms in one plane that are bisected by diametrical strips set into another plane and affording special anchorage for the fabric in the mass of concrete.

It is designed to strengthen the concrete for flexure, contra flexure, and shear stresses and to distribute surface loads uniformly.

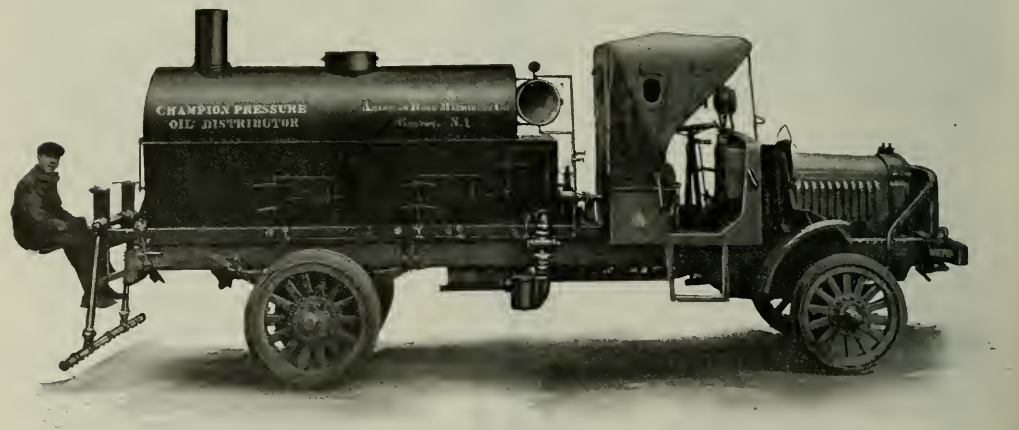
It is intended for use on concrete roads, retaining walls, culverts, docks, foundations, floors, roofs and tanks.

INDUSTRIAL NOTES

The Keystone Concrete Block Co., Rochester, N. Y., has been appointed vicinity representative of the Consolidated Expanded Metal Co., of Braddock, Pa., for the distribution of steelcrete "Rid-gid," metal lath double-diamond road reinforcement, and other specialties.

William S. Moore, formerly city engineed of South Bend, Ind., and Charles W. Cole, a member of the Indiana Board for the Registration of Engineers and Surveyors, have formed an engineering partnership with offices in South Bend.

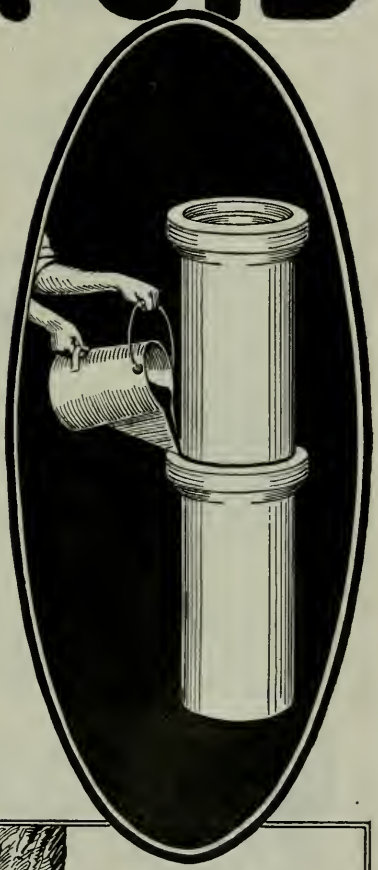
John G. Hirsch, formerly supervising engineer for Lockwood, Greene & Co., engineers, Chicago, and Stone & Webster, Boston, has become associated with the Benham Engineering Co., consulting engineers of Kansas City, Mo., as principal assistant engineer.



CHAMPION PRESSURE HEATING DISTRIBUTOR WITH TWO-SECTION MANIFOLD FOR HOT APPLICATION OF ALL KINDS OF ROAD OILS.

RU-BER-OID

PIPE-SEAL Will Prevent This



It cost approximately $2,350 to clean roots from three miles of sewer in Schenectady, New York, last year and Schenectady has 150 miles of sewer!

The employ of Ruberoid Pipe-seal in the original construction would have saved all this because Ruberoid Pipe-seal is a joint compound that prevents the penetration of roots. Besides saving this money, the ordinance passed several years ago requiring the removal of all poplar trees in the vicinity of a sewer would not have been necessary.

Ruberoid Pipe-seal, besides being thoroughly effective in preventing root penetration, is proof also against infiltration, resist the action of sewage acids, and makes a tight, flexible joint that allows for any subsequent settling of the pipe.

Send for our Ruberoid Pipe-seal folder which, besides a description of the properties of the compound, contains instructions for its application.

The RUBEROID Co.
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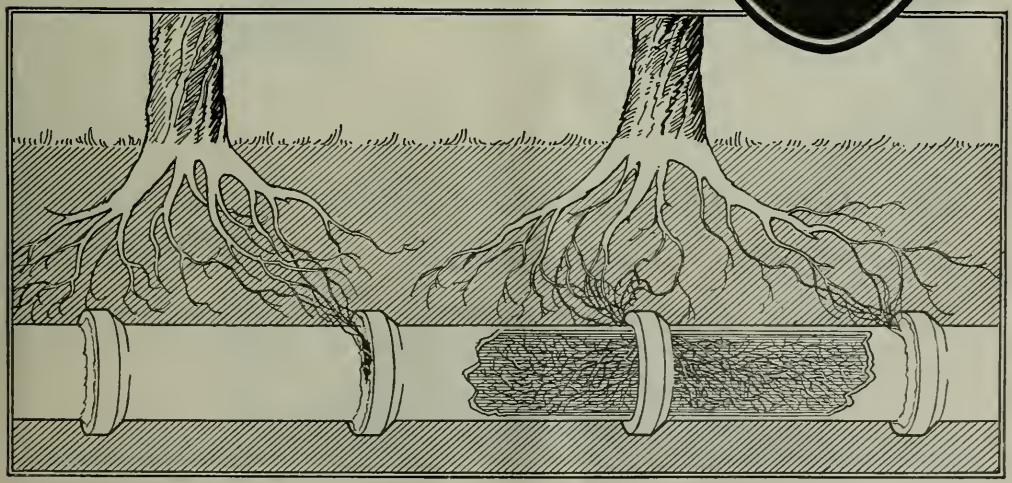
Chicago Boston



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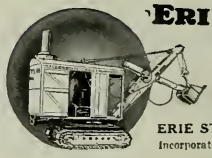

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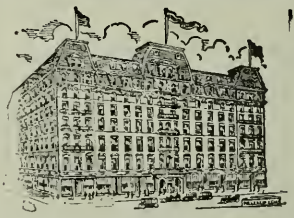

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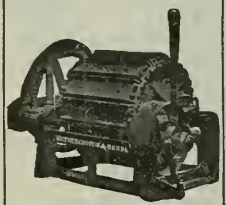
N. P. B. M. Standard Rattler



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Latest Improvements
and refinements of construction that have been found desirable during a period of try-out covering almost one year of time and conducted under the direction of the technical committee of the National Paving Brick Manufacturers' Association.
For descriptive circular and prices address
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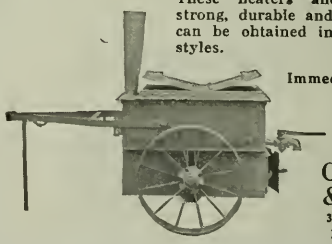
Immediate Shipment
Write at once for complete catalog and prices.



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One More Triumph for Acme Engineers
A Machine that is Constant—Dependable Powerful
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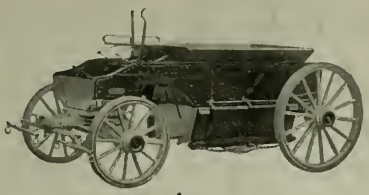

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In closing the bottom doors, one side always shuts first, making a dirt-tight joint.

Its light draft, large wheels and short turning radius, make it unusually desirable for road work.

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Columbia, Pa.

We build the Jennings Automatic Dump Body for Ford Ton and other makes of Ton Trucks. Send for circulars.

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All kinds of Semi-trailers Heavy duty special trailers

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A Trailer For Every Purpose

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"A MIX A MINUTE"

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With this machine you can insert new valves in existing lines under pressure, avoiding annoyance to consumers and also avoiding great fire risks.

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The A. P. SMITH MFG. CO.

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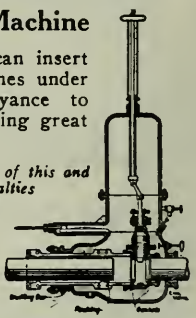

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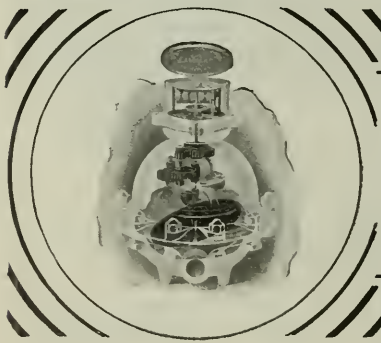

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 June 24, 1922 No. 25

Improving East Ohio Street, Pittsburgh

Widening and raising, lifting water mains in service, building high retaining walls and paving one and one-half miles of an irregular side hill street at a cost of approximately $525,000

East Ohio street, Pittsburgh, runs approximately northeast near the shore of the Monongahela river and adjacent to a number of tracks of the Pennsylvania railroad. It is at the foot of a very steep, high, rocky hillside which in some places intersected the roadway, and in other places receded somewhat from it, affording sites for buildings north of the street.

The street was partly unimproved and partly paved with stone blocks and at the west or city end there were several hundred feet of 54 and 36-inch brick sewers and of terra cotta pipe sewers from 15 to 18 inches in diameter with pipes, laterals, manholes and other appurtenances. Two tracks of the Pittsburgh Street Railroad electric car line were installed in the street, which also carries a traffic of heavy trucking and automobiles, horse-drawn vehicles and pedestrians.

The width and grade of the street were very irregular, the width at some places being as little as 30 feet and some grades as steep as 4 per cent. Along the east side of the street the roadway was protected for about two thousand feet by an old stone masonry retaining wall, close to the foot of which the Pennsylvania railroad main line tracks were laid. The top of the wall was surmounted by a high wooden picket fence. The street was poorly lighted and graded and generally in poor repair.

In order to provide a much needed betterment, the improvement of the street was authorized and work commenced May 24, 1920, on a contract which was awarded to the Thomas Cronin Company, which completed it December 13, 1921.

FORMS ASSEMBLED AND SHEETING TEMPORARILY BRACED FOR CONCRETING. FINISHED WALL IN BACKGROUND.

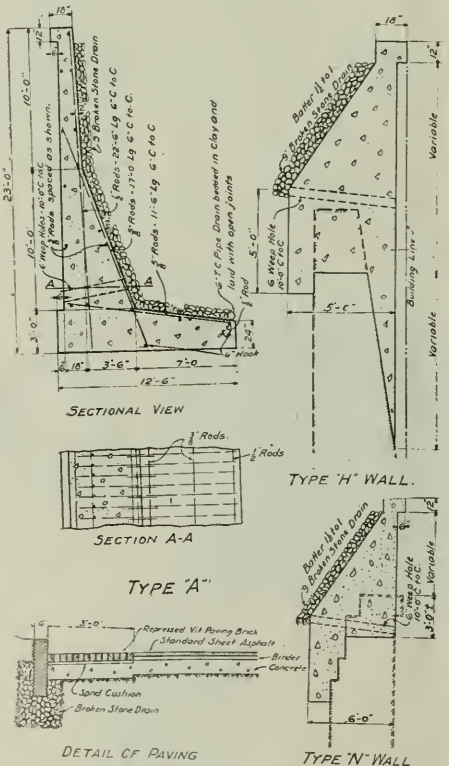
The principal items of the contract included building the street to a uniform width of 56 feet, including one 10-foot sidewalk on the up-hill side of the street, elevating the surface to a maximum of 6 feet additional height, changing the grade to a general slope of eight-tenths per cent in most places, building a concrete retaining wall over a section of

street 7,000 feet long, paving with sheet asphalt, draining, curbing and the like.

GRADING AND MOVING

The widening and grading involved about 33,000 cubic yards of earth and rock excavation, chiefly executed with two large Marion steam shovels. Before the excavation could be completed it was necessary to raze or move about 60 public and private buildings some of them being shifted from one foot to twenty-five feet. The most important of these was a 65 x 110-foot church weighing about 4,500 tons, which was moved backward 20 feet on 1,000 rollers after an excavation had been terraced in the hillside to receive it, as described in Public Works, November 19, 1921. The subcontractor, the John Eichleay, Jr., Co., Pittsburgh, received about $60,000 for this difficult and delicate work, which preserved intact the $90,000 church without interrupting its services or injuring the structure or its decorations and contents.

The street car tracks were adjusted to correspond with the new grade and were placed on a concrete foundation with stone ballast, the work being executed by the Street Railway Company without interrupting the electric car traffic, although the vehicular traffic was detoured for a period of about 90 days during the progress of the reconstruction.

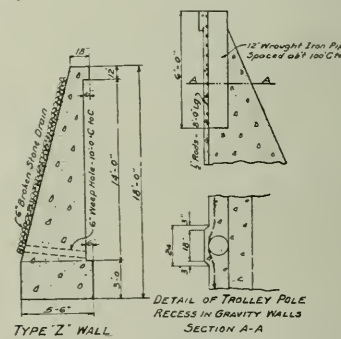


WALL A, TYPICAL OF HIGH, REINFORCED CONSTRUCTION. WALLS H AND N, EXTENSIONS OF OLD RETAINING WALL

It was also necessary to raise about 3,000 linear feet of 20-inch and 42-inch water mains about 8 feet while in service under a pressure of 91 pounds per square inch. This was accomplished in 90 days, by 150 men, who handled the pipe in sections 240 feet long which were successively raised about 3 to 4 feet in the center for each operation by means of an equipment of 25 ten-ton jack-screws operating chain slings 12 feet apart in which the mains were suspended from overhead crossbeams on blocking. Care was taken to operate the jack-screws uniformly and simultaneously by signal so that those at the extremities of the section should be turned through definite vertical spaces increasing from one-quarter inch to secure a 3-inch hold at the middle when the jacks were reset, and avoid injurious strains to the pipe.

RETAINING WALLS

At the commencement of operations the south side of the road was protected by 2,800 feet of old stone masonry retaining wall, which was not high enough for the increased grade and required the construction of 1,500 feet of new concrete retaining wall on top of the old wall, besides which there was built 2,300 feet of independent retaining wall up to 23 feet in height between the railroad and the roadway. On the opposite or north side of the


12" Wrought Iron Pipe Spaced 6'0" C to C.
6" Broken Stone Drain
6" Weep Holes 10'0" C to C
TYPE "Z" WALL
DETAIL OF TROLLEY POLE RECESS IN GRAVITY WALLS
SECTION A-A

WALL Z, RETAINING HILLSIDE ABOVE THE ROADWAY. POLE RECESS IN WALL ON RIVER SIDE.

roadway, it was also necessary to build 500 feet of retaining wall up to 30 feet in height, to protect the road from the earth and rock in the hillside cut. These retaining walls all had gravity sections.

Some of the walls were reinforced and some were not, and their dimensions varied greatly, so that nearly 30 different types were required for the conditions encountered throughout the work. The typical ones are indicated in the cross sections, which show the principal features of cuts and fill, the varying positions of the present railroad tracks and their future elevation and the general character of the cut and fill work. All of the types were carefully dimensioned and detailed to correspond substantially with those shown.

Excavation for the retaining walls was chiefly made by hand and by a clam shell bucket which, together with the spoil bucket, was handled by a locomotive crane installed on the roadway at the top of the wall and also used to handle the heavy timber

WIDENING STREET BEHIND WALL RETAINING SIDE HILL FILL.

forms that were made in large panels for the concrete work.

CONCRETING

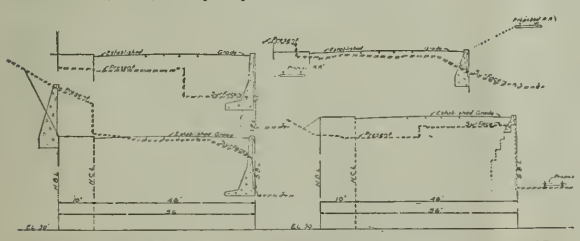
As the excavation was made for the retaining wall, one side of the trench was sheeted with 2-inch wooden planks placed by hand and securely braced by rangers and inclined struts. The latter were removed after the forms for the face of the wall had been placed, thus permitting the sheeting to serve as the form for the rear of the wall, most of the sheeting being left permanently in position and covered by the back fill, which was placed by hand.

Concrete materials were delivered in the road by motor trucks and the concrete was machine-mixed and spouted directly to position in the forms through short wooden chutes handled by the locomotive crane in special places and generally for the retaining wall on the opposite side of the road which protected the face of the bluff.

UNIT PRICES

The total force employed averaged about 150 men and the work was executed under the direction of A. N. Dick, senior assistant engineer, Pittsburgh Department of Public Works, Bureau of Engineering, John Swan, director, C. M. Reppert, chief engineer, and Tom M. Reed, assistant chief engineer.

The principal items of the contract included 33,230 yards of embankment at $1; 15,000 yards of excavation; 17,050 square yards of new standard sheet asphalt pavement at $3.40 per yard; 4,900 square yards of new vitrified brick pavement, at $0.50 per yard; 7,753 lineal feet protected concrete curb type one, at $1.30 per foot; 74,500 square feet concrete sidewalk type one, at $0.30 per square foot; 5,440 yards plain concrete in the retaining walls, at $14.50 per yard; 7,308 yards reinforced concrete in retaining walls, at $15 per yard; 375,300 pounds steel reinforcement, at $0.06 per pound; 6,476 lineal feet of standard fence No. 7, at $0.50 per foot and about 20 minor items.



GENERAL CROSS SECTIONS SHOWING CHARACTERISTIC FILL, SIDE HILL EXCAVATION AND RETAINING WALLS.

Don'ts for Sewerage and Water Works Designers

Features to be Avoided in Designing Sewerage and Water Works Systems, as Set Forth by the State Board of Health of Minnesota

In its instructions for the submission to it of plans and specifications of proposed water and sewerage systems, the State Board of Health of Minnesota presents a number of "Features to be Avoided" in preparing the designs. The following paragraphs are quoted from the Board's instructions, as revised in May, 1921.

WATER WORKS DESIGNS

The following is a brief statement of some of the features to be avoided in the design of a water supply system, since they have been found to be dangerous from a sanitary point of view. Plans including these features will not receive the approval of the State Board of Health.

1. Wells, pumping apparatus, exposed suction mains, reservoirs, and filters located where they will be subject to flooding with surface water during high water periods.

2. The improper construction of well casings and covers and the lack of adequate provision for surface drainage to prevent pollution with surface water. The outer casings of drilled wells shall extend to a height of at least 6 inches above the pump room floor and a suitable connection made between it and the drop pipe which will effectually prevent waste water from entering the well.

3. Pits around drilled wells, where pumps of the deep well type, or so-called vertical turbine type, are used. Where water is pumped from drilled wells by means of suction pumps of the reciprocating or centrifugal type directly connected to the well casing, it shall be permissible to construct a pump room, the floor of which may be below the surface of the ground. In this case the well casing shall project to a height of at least 12 inches above the pump room floor. The pump shall be placed upon suitable foundations of sufficient height so that no part of the suction pipe, valves, etc., will be at an elevation lower than 6 inches above the pump room floor. Water tight screw or flanged connections should be made between the top of the well casing and the suction pipe. The pump room floor shall be sloped to drain away from the well casing and pumping apparatus towards a water tight sump located at least 4 feet from the well. This sump shall have a capacity of at least 12 cubic feet. A pump shall be provided to remove any waste water, or seepage, collecting in the sump, to the surface of the ground. Where possible this pump shall be ar-

ranged for automatic operation. The walls of the pump room shall project to a height of at least 1 foot 6 inches above the general level of the ground surface and 6 inches above the grade line of the building.

Where it is necessary to pump from a series of wells by means of suction mains leading to a central pumping station, and where it is impossible to locate the suction mains above the ground surface, the manholes around all wells and valves on the suction pipes shall project to a height of at least 1 foot above the ground surface. In case it is necessary to locate remote controlled suction pumps in pump pits at the wells which are isolated from the central pumping station, the walls of these pump pits shall project to a height of at least two feet above the ground surface. These manholes and pump pits shall be water tight, of brick or concrete construction, and shall be provided with manhole openings equipped with rings having raised edges and with solid covers with overlapping edges. Pump pits should be provided with sumps and automatic ejectors wherever possible.

4. Improperly constructed underground or surface reservoirs. Underground and surface reservoirs shall be water tight and constructed of some permanent, substantial material. Manhole openings to underground reservoirs which are covered with earth shall project to a height of at least 12 inches above the ground surface. These manhole openings shall be provided with solid water tight covers having overlapping edges which shall be provided with locks. The edges of manhole openings to surface reservoirs, the tops of which are above the ground surface, shall project to a height of at least 3 inches above the top of the reservoir. These openings shall be provided with solid water tight covers having overlapping edges and shall be provided with locks. Reservoirs shall be constructed without ventilators. Properly constructed vents located in the roof are permissible. Cleanouts to reservoirs shall not have connections with sewers, or to any body of water the surface of which is or may be raised to an elevation higher than the bottom of the reservoirs.

5. The connection of any part of the system with sewers by means of which it is possible for sewage, even under exceptional circumstances, to back up into the wells, storage reservoirs, etc., and thus pollute the supply.

6. Systems using surface water without adequate treatment. The treatment required will depend upon the local conditions.

7. Emergency connections by means of which untreated surface water, or water of questionable or unknown sanitary quality may be admitted to the system.

In case it is necessary to supply water from the mains of a water system which is known to be satisfactory to some other system using water of unsatisfactory sanitary quality, the method of supplying water to such a system shall be as follows:

By means of a pipe delivering the water to a tank or reservoir on the other system. This pipe shall be so installed that the water will be discharged into the tank or reservoir from an elevation of at least 6 inches above the rim of the tank.

SEWERAGE DESIGNS

The following is a brief statement of some of the undesirable features which should be avoided in the design of sewerage systems, since they have been found to be unsatisfactory. Due to the relatively long Minnesota winters, it is necessary to design sewage treatment plants on a different basis than would be used in milder climates. Plans which show undesirable features and which do not comply with the following requirements will not be approved except when some valid reason is offered for doing otherwise.

1. Sewerage systems of the combined type, removing both domestic sewage and street drainage in the same pipes. Pipe collection systems, with rare exceptions, shall be of the separate type. The sanitary sewers shall be designed to remove house sewage and basement drainage only. All street and roof drainage shall be excluded from the sanitary sewers. A liberal allowance shall be made for ground water, depending upon local conditions.

2. Sewer pipes with grades which are less than those given in Table A shall not be used unless absolutely necessary.

Table A

Size of pipe	Grade (Fall in feet per 100 feet of sewer)
6 inch	0.60
8 "	0.40
10 "	0.29
10 "	0.22
12 "	0.16
18 "	0.12
20 "	0.10
24 "	0.08

If it is necessary in any case to use grades less than these given in Table A, a written statement explaining the reason for using such grades shall accompany the plans, and flush tanks shall be provided at the upper ends of all lateral and main sewers which are laid with grades less than those shown by Table A. In no case shall grades be used which are less than those shown in Table B. Engineers are cautioned against specifying pipes of sizes which are obviously larger than necessary for carrying capacity, but which are used in order to meet grade requirements.

Table B

Size of pipe	Grade (Fall in feet per 100 feet of sewer)
6 inch	0.33
8 "	0.25
10 "	0.23
12 "	0.20
15 "	0.16
18 "	0.12
20 "	0.10
24 "	0.08

3. Manholes spaced too far apart, or omitted entirely. Manholes shall be provided at all street intersections. Whenever the length of a sewer between any two street intersections is more than 500 feet and less than 700 feet, a lamphole shall be located midway between the intersections. Wherever the length of a sewer between any two street intersections is more than 700 feet, a manhole shall be located midway between the intersections. Lateral and trunk sewers shall be laid with a minimum cover of 6 feet wherever possible. This does not apply to outfall sewers.

4. Sewage treatment plants designed without some knowledge of the amount of sewage to be

treated. In case of an entirely new system, the sewage treatment plant shall be designed on a basis of the average rate of flow of sewage of not less than 60 gallons per capita nor more than 100 gallons per capita per 24 hours for the number of persons for which the plant is designed. Where sewage treatment plants are to be installed in connection with existing systems, measurements on the dry weather flow of sewage shall be made. The number of house connections shall be ascertained and a record made of the number of houses in the sewer district. This information shall be submitted with the plans.

5. Sewage treatment plants without by-pass pipes. It is often necessary or desirable to temporarily pass the sewage around all, or some part of the plants. In every case where a plant is installed to treat the sewage from a system of the combined type, the excess storm water shall be excluded from the plant by means of overflow or leaping weirs.

6. Screen or grit chambers, if required as a part of the sewage treatment plant, should be relatively small and designed so that the screenings and grit can be easily removed by the operator. The grit chamber should not be large enough to permit material to deposit which should be carried into the settling tank.

7. Imhoff tanks should be designed so as to provide for an average period of sedimentation of between two and three hours. The sloping walls of the settling chamber shall have a minium slope of 1.0 horizontal to 1.2 vertical and shall be finished smooth. A steeper slope is preferable. The settling chamber should be approximately 1 1/2 to 2 1/2 times as long as it is wide, and the depth from the surface of the water to the slots should be approximately equal to the width of this chamber. Baffles should extend across the settling chamber near the inlet and the outlet ends. The inlets and outlets should be so located as to distribute the flow equally across the entire section of the settling chamber. Inlet and outlet pipes shall be designed to be self cleaning under all conditions. Weirs should be relatively narrow and adjustable. The slot or slots between the settling chamber and the sludge compartment should have a clear opening of at least six to eight inches. The overlap, or horizontal projection at the slot, or slots, should be at least four inches. Tanks with two or more sludge chambers in series shall be of the reversible flow type.

In cases where the pipe collection system is of the separate, or sanitary type, the sludge compartment shall have a capacity of at least two cubic feet per capita for which the plant is designed. Where the plant is designed to treat the sewage from an existing sewerage system of the combined type, the sludge compartment shall have a capacity of at least 50 per cent. larger than would be required if the system were of the separate type. In computing the size of the sludge compartment, only that portion of the sludge chamber shall be considered which is below a horizontal plane located two feet below the slot, or slots, in the bottom of the settling chamber, and above a surface developed by a line drawn at an angle of 30 degrees with the horizontal drawn from a point at the bottom of the sludge chamber 8 inches below and directly under the lower end of the sludge removal pipe. Suitable pipes for conveying water under pressure to the sludge compartment for the purpose of agitating the sludge shall be provided. Water under pressure for use with a hose shall be provided. In case the plant is located where water from an established water supply system cannot be furnished conveniently, a pump may be installed to pump clarified sewage from the settling chamber, or some other convenient point. This pump should have a capacity of at least 50 gallons per minute when pumping against a pressure of 40 pounds per square inch.

In order that the operator can have free access to the tank, it should be designed to be entirely uncovered during the summer months, except when tanks are enclosed in buildings. Light, easily handled, wooden covers should be provided for winter use. If it is considered necessary or desirable to provide a building over the tank, the building shall have sufficient clear head room so as not to interfere with the operator of the plant. The clear head room below all obstructions above the surface of the water shall be at least 4 feet more than the distance from the surface of the water to the slots. Eaves shall not project over the vents to such a distance that a pole cannot be thrust into them to the bottom of the tank. Sludge removal pipes shall be straight and shall be from 6 to 8 inches in size. They shall be so designed that a rod can be introduced into the pipes for the purpose of agitating the sludge, and to facilitate its removal. The sludge should be discharged by gravity to the drying bed wherever possible. The available head on the discharge pipe shall not be less than 4 feet. A greater head is preferable. If it is necessary to remove the sludge by pumping, the pump shall be located at an elevation at least 4 feet below the surface of the water in the tank. Provision shall be made for replacing the sludge in the sludge pipe with water after it has been used in removing sludge from the tank. This is to prevent the sludge pipe from becoming filled with stiff sludge which will be hard to remove. The type of sludge pump shall be specified.

8. The sludge drying bed should be located as close as possible to the Imhoff tank in order that the sludge removal pipe may be short. If it is necessary to locate the sludge drying bed at any great distance from the tank, the sludge shall be conducted to the bed in an open trough. The surface of the sludge drying bed shall be from 18 to 24 inches below the outlet end of the sludge removal pipe. The sludge drying bed should have an area of approximately one square foot per capita for which the tank is designed. It shall be curbed to prevent earth from washing into it, and should be adequately underdrained. Due to the fact that sludge which has been drawn from the tank to the drying beds is often rained upon before being completely dried and ready for removal, it is suggested that the beds be covered. The roof over the beds should be at least 8 to 10 feet above the surface of the beds so as not to interfere with the removal of the sludge. The sides should be open.

9. Percolating filters should be conservatively designed as to capacity. Filters may vary in depth from 5 to 9 feet. The rate of flow depends somewhat upon the depth of the filter and the size of the filter material. An average rate of flow of about

1,200,000 to 1,500,000 gallons per acre per day for a filter 6 feet in depth is recommended for Minnesota conditions. Filters should be uncovered except where the sewage must be filtered during the winter months. The sewage should be distributed onto the filters by means of sprinkling nozzles.

10. A resettling tank having an average holding period of about one hour shall be installed wherever percolating filters are used. This tank shall be provided with cross baffles. The bottom shall be hopper shaped. Adequate provision for sludge removal shall be provided in accordance with the requirements for the removal of sludge from Imhoff tanks. The sludge drying bed shall be constructed in a manner similar to the bed for drying the sludge from Imhoff tanks. This bed shall have a net area equal to at least one-half a square foot per capita.

11. The entire plant should be surrounded by a substantial fence for the purpose of keeping out unauthorized persons, or animals.

12. Sewer outlets into streams, or lakes, shall be so designed that the sewage will be discharged under water wherever possible. Wherever the sewage is discharged into streams, it should be discharged directly into the main current. If discharged into a lake, the sewer outlet shall be at least 50 feet into the lake from shore, or farther if necessary to obtain a sufficient depth to prevent freezing of the outlet pipe, and at a point as far as possible from bathing beaches and waterworks intakes. Sewer outlets shall be suitably protected against damage by high water, or ice, by the use of bulk heads, or rip-rap or both.

Construction of Loch Raven Dam*

By Wm. A. Megraw

Methods and equipment used in mixing and placing the concrete. Fastening the face forms in place. Inventory of Contractor's plant. Cost of the work.

MIXING AND PLACING CONCRETE

Water for the concrete is taken from the river above the dam and measured by two barrels pivoted on their centers and so placed that each will empty into a mixer by hand. Each barrel has a 2½-inch quick-opening valve and a mark on the inside to indicate the quantity of water desired.

The sand and stone bins each discharge through a separate chute to a hopper located over a concrete mixer, the hopper being calibrated to measure the quantity of sand and stone required for one batch of concrete and designed to dump all material simultaneously into the mixers. Two one-yard mixers have been used, a Smith tilting mixer and a Ransome non-tilting mixer. For work of this character, it developed that the Smith tilting mixer gave better results than the Ransome non-tilting mixer.

The concrete is elevated from the mixers by

*Continued from page 439.

FIG. 1.—VIEW OF LOCH RAVEN DAM CONSTRUCTION, LOOKING TOWARD WEST END
At extreme left background is trestle carrying rock cars to crusher. At right of crusher are aggregate bins, with mixers below, and tower. In the foreground is the secondary tower for distributing concrete to the east end. Face and joint forms are seen in place, with top of old dam in the foreground.

buckets operating inside of a double wooden tower 204 feet high and is distributed by chutes to the desired points. The concrete buckets are raised by engines, one for each bucket, located at the elevation of the highway about 76 feet above the bottom of the lower pit.

The dam is built in 60-foot lengths, separated by transverse expansion joints extending continuously through the cross sections; 5/16 inch by 12-inch vertical steel plates, placed 18 inches back of the up-stream face, being used to seal the expansion joints. The up-stream face of the dam is composed of 1-2-4 concrete placed in 8-foot lifts extending alternately 6 feet and 7 feet back from the face. The remainder of the section is composed of 1-3-6 concrete. The following concreting procedure generally was followed:

First, a lift of 1-2-4 concrete, 60 feet long between expansion joints was deposited. After twelve hours, the forms were removed and 1-3-6 concrete was then deposited in one operation from the back of the 1-2-4 concrete to the down-stream face and for a full length between expansion joints. The 1-3-6 concrete was generally brought 1 foot higher than the 1-2-4 concrete. The two grades of concrete thus break joints both horizontally and vertically, and the only vertical joints, except the expansion joints, are those between the two grades of concrete.

Six-inch by 12-inch horizontal bonding grooves 2 feet back of the front face, and a 14-inch by 14-inch porous block drain 2 feet further back from the face, were placed in the 1-2-4 concrete at the completion of each lift. The bonding groove and groove for the tile drain were cut out by hand as soon as the concrete had sufficiently hardened. The ends of the tile drain are covered with burlap dipped in tar, and the space between the tile and groove filled with dry sand. At each expansion joint, the porous drain enters a 3 x 3 foot well that extends vertically upward and downward to galleries respectively above and below the highest and lowest horizontal joints, by means of which inspection can be made of the seepage through the dam. The lower gallery is drained into the tail water on the downstream side. Vertical bonding grooves 2 feet wide by 7 feet deep and 10 feet apart, bond the masonry across the expansion joints.

The 1-2-4 concrete shown on the plans for the downstream face was omitted and 1-3-6, deposited as described above, was substituted. The placing of forms on the downstream face presented a problem. There was no way of supporting them from the interior without leaving considerable timber in the concrete, and supporting them from the outside would have been expensive. The problem was solved by wiring the forms to dowels inserted in the existing concrete. A few props held the forms in place ready for pouring. As the concrete was deposited, the pressure soon became sufficient to keep the forms from collapsing, and the props were then removed. It was necessary to drill holes in the old foundation concrete for the dowels, but above that elevation, at the end of each day's pour as soon as the concrete had set sufficiently, pieces of scrap pipe were put in place to serve as dowels.

In the gate chamber one 24 x 24-inch and eleven 6 x 3.5-foot gates were placed. The specifications provided that all gates be securely blocked and fastened in position before concreting. The gates will be operated by stems varying in length from 50 feet to 75 feet and were required to be set exactly plumb, but as each gate weighs 4,700 lbs., it was practically impossible, with the means available, to sustain them in place while concreting around them. In construction, therefore, the bolts for the gate frames were set as the concrete was deposited and the gates and gate frames were set after concreting of the gate chamber had been completed.

The rock stratification on the east hillside is so much inclined from the horizontal that it was impossible to expose a large face without causing a rock slide. It was possible, however, by stepping the foundation, to keep a rugged wall of rock against which to place concrete. About 2,000 yards of solid rock was estimated, but owing to the sliding ten-

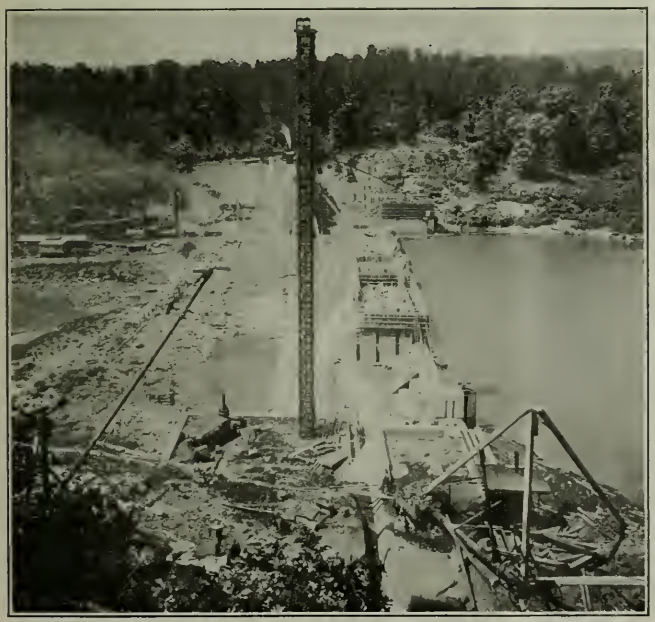


FIG. 2.—LOOKING TOWARD WEST END THREE WEEKS AFTER DATE OF FIG. 1. SHOWS VERTICAL BONDING GROOVES AT EXPANSION JOINT.

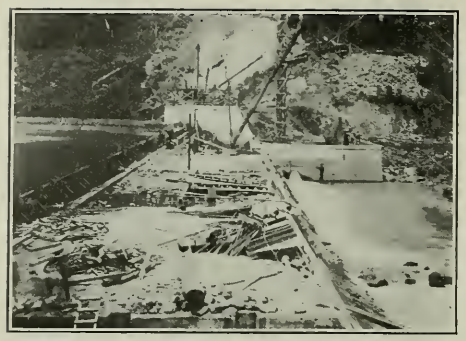


FIG. 3. ROCK SLIDE AT FURTHER END OF DAM.

dency, over 5,000 yards was excavated. Excavation for the east abutment was started before completion of the construction plant, yet, due to the difficulties encountered, this portion of the dam was the last completed.

CONTRACTOR'S PLANT

In order to convey concrete from the mixers on the west side of the river to the easterly part of the east abutment, the concrete was rehandled at the east tower. An elevator bucket within the tower was filled from the line chute, then elevated, and the contents emptied into a second chute higher on the tower. The east tower is 168 feet high and the west tower 204 feet high. The towers are 340 feet apart and connected by a 1¾-inch cable which carries the concreting chute.

The capacity of the plant is about 600 cubic yards of concrete per 10-hour day, although at times 700 cubic yards have been placed in that time. The average per working day was 300 cubic yards. A considerable portion of the contractor's plant had been used before, but the loss due to breakdowns was not excessive. The records of the resident engineer show a loss of 483 working hours. Of this time, 48 per cent was due to breakdowns and other troubles with the mixers, 22 per cent to changing and clogging of chutes, 14 per cent to accidents in the towers, and 15 per cent to lack of forming space and other causes. On the whole, the work progressed with rapidity, which was due in part to the hearty cooperation between the contractor and the engineers.

The following is a list of the contractor's equipment:

1 — Marion 31 revolving steam shovel.
1 — Erie type "B" revolving steam shovel.
1 — Marion 61, railroad type, steam shovel, gasoline pumping outfit.
1 — 18-ton Vulcan narrow gauge dinkey.
1 — 14-ton American narrow gauge dinkey.
10 — Koppel 4 yd. dump cars.
10 — Western wheel scraper 4 yd. dump cars.
1 — 325 cu. ft. Ingersoll-Rand steam driven air compressor.
1 — 160 cu. ft. Chicago Pneumatic Tool air compressor.
1 — Bull Dog 20" gyratory crusher—rated capacity 1,500 tons 10 hrs.
1 — 175 h.p. horizontal Corliss valve steam engine, driving crusher.
1 — 24" rock bucket elevator.
2 — 20" belt conveyors—1 driven by 12 h.p. vertical steam engine, and 1 by 12 h.p. Otto gasoline engine.
1 — Link belt sand washer.
1 — Steam driven duplex pump, 6" suction, 5" discharge, for general water supply.
2 — Duplex boiler feed pumps.
1 — 15,000 gal. wooden tank for water supply.
1 — 150 h.p. locomotive type boiler.
1 — 150 h.p. Scotch marine boiler.
1 — 60 h.p. vertical boiler.
1 — 30 h.p. vertical boiler.
1 — Ingersoll-Rand drill sharpener, air operated.
1 — Circular saw.
1 — Band saw.
1 — Grinder.
1 — Power operated pipe-threading machine.
1 — Contractor's equipment 7, ½" x 10" double-drum hoisting engine with boiler.
1 — 3-drum, 8 x 12 Mundy hoist with boiler.
1 — 8 ¼ x 10 double-drum Lidgerwood hoist with boiler.
1 — 8 x 10 Lidgerwood hoist with boiler.
1 — 5 x 8 double-drum hoist with boiler.
1 — 7 x 10 American double-drum hoist with boiler and boom swinger.
1 — 8½ x 10 double-drum Lambert skeleton hoist.
1 — 6½ x 12 double-drum Mundy hoist.
1 — Stiff-leg derrick 15T capacity with 65 ft. boom.
1 — " " " 15T " " 60 " "
1 — " " " 5T " " 50 " "
1200 linear ft. of Lakewood chutes.
2 No. 3½ Keystone well drills.

COST OF THE WORK

About 45,000 yards of concrete are required under the present contract, and the cost of all items will amount to about $525,000. The principal unit prices are as follows:

Loose rock excavation.....	$ 4.69	per cu. yd.
Solid rock excavation.....	6.67	per cu. yd.
Concrete for balustrades.....	20.60	per cu. yd.
1-2-4 mass concrete.....	11.85	per cu. yd.
1-3-6 mass concrete.....	10.34	per cu. yd.
Steel reinforcement	.04¾	per lb.

50,800 cubic yards of 1-2.5-5 and 1-2-4 concrete were placed under a previous contract, the cost of all work under which amounted to $527,000. The total cost of the dam from bottom to top is, therefore, $1,052,000.

The writer is indebted to C. K. Allen, resident engineer, for a portion of the information contained in this article.

The Bates Experimental Road

A few weeks ago we described the result of the second run of the test of the Bates experimental road, which test is being conducted by the state of Illinois. A third test was completed a few days ago, and will be described in the next issue of Public Works. In the third test the trucks carried 4,500 pounds on each rear wheel for 3,000 applications. A fourth test is to be made with 5,500 pounds on each rear wheel for 3,000 applications.

We referred in a previous article to the fact that the subgrade of this road was quite wet, thus presenting very unfavorable conditions. W. P. Blair, vice-president of the National Paving Brick Manufacturers' Association, after visting the road a few days ago, reported that: "Water has disappeared entirely from the side open ditches and is oozing from beneath only one section of the pavement, so far as I was able to observe. On a previous inspection water was oozing from beneath all sections of the pavement. It may never become known to what extent the water in the various sections has contributed to the injury of the pavement thus far observed."

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State Advice on Sewer and Water Designing

The majority of states now have sanitary engineers or sanitary engineering departments connected with their state health boards and these generally exert more or less control over the construction of sewer and water works systems throughout the state. In the majority of cases, probably, the state health board engineer confines himself to approving or disapproving plans submitted, although he is generally ready to consult with the designing engineer before he begins preparing his design with a view to informing him whether the general plan which he proposes to follow will be acceptable.

A few of the states go further than this. Minnesota has prepared and published a quite extensive statement of features that are to be avoided in designing water works or sewer systems, and these instructions are published elsewhere in this issue. It will be noticed that these confine themselves, in the case of water works at least, exclusively to features affecting the health of the community.

Under the head of sewerage designs the board seems to go a little further and insists on adequate grade to the sewers so that stoppages may be reduced to a minimum, and the use of flush tanks wherever low grades are used. The greater part of the instructions in connection with sewerage, however, are for the designing of sewage treatment plants and especially Imhoff tanks. It would almost seem as though the instructions for these went unnecessarily far in specifying details of the design.

There are advantages in informing designing engineers beforehand just what the state board will require in its designs, so far as these can be specified beforehand. There is danger, however, as has been illustrated by the history of state health board oversight in one or two of the states, that the establishing of rules of this kind may retard progress in that the board hesitates to change rules which interfere with the introduction of new ideas on the subject, until such time as they are absolutely certain that these new ideas are sound—that is, until other states less conservative have permitted their cities to try out these ideas and demonstrate their acceptability.

It seems to us undesirable that health boards should act as a brake to the wheels of progress, but that it would be best should the board confine itself to seeing that plans as adopted are not antagonistic to the health of the citizens of the state, permitting the cities themselves to decide all questions of finances connected with the construction of their sewage treatment plants or other features of sewerage systems, and even to take occasional chances in testing out new ideas. If all the cities in all the states should be barred from trying anything new, all progress in sewerage and sewage treatment would be blocked indefinitely.

Arbitration of Contract Disputes

The contract and specifications for construction work are or should be instruments intended solely to determine, with the drawings, what the engineer and owner wish to purchase, how and with what it must be produced and the manner and amount of payments, thus affording opportunity for the meeting of the minds of both parties to the contract and the definite statement of their mutual obligations.

It is generally provided that the owner's engineer shall be the final authority in the interpretations and decisions, which is the simple and natural procedure, providing all parties are fair-minded, competent and reliable.

It is, however, entirely possible that unforeseen conditions and developments may arise that cannot be properly provided for in advance by the contract and specification and should certainly be subject first to conference and agreement between the parties of the contract and afterwards, if necessary, to impartial decision by a third party. A general clause providing for this can easily and properly be inserted in every contract and if present should not be protested by any fair-minded person.

In the case of a large amount of construction work in Louisville, mentioned on page 464 conditions were such that all the principal contractors demanded in advance provision for arbitration and refused to consider the work without it. We do not know what conditions impelled this action, but, obviously, some reasons for dissatisfaction were felt to exist and the fact that they were so potent before the commencement of the work lends color to the possibility of justification of their demand, because of the refusal of the owner's attorney to consent to arbitration.

Under a considerate and impartial supervision and investigation of specifications, the necessity for arbitration will be felt and when it occurs it should be cheerfully and thoroughly accepted by both parties. The denial of this fundamental provision which should be equally beneficial to both parties is of itself suspicious and it is to be hoped that the contractors will continue to refuse to undertake work in which there is any reasonable grounds for expectation of unfair treatment. Occurrences of this sort afford opportunity for important and desirable investigations and recommendations by the local and national associations of the contractors, engineers and lawyers.

Settlement of Soils Under Loads*

Large machine recommended by the American Society of Civil Engineers as standard for making tests.

The proposed standard large type of load testing apparatus for soils recommended by the committee of the American Society of Civil Engineers was used, practically without modification, for tests made at the site of the Standard Oil Office Building, San Francisco, by Frank A. Johnson and by the city of Seattle, Washington, A. H. Dimock, city engineer and F. A. Rapp, bridge engineer.

In the San Francisco test two record boards in planes at right angles to each other were installed and the average of the readings, which differed little from either one, was used. The hopper was loaded with sand, but it was considered that a water load would have been preferable because great care was necessary in applying the sand increment and because a light jar of the hopper was transmitted with greater intensity to the post. It was suggested that the use of burlap under the compression plate was desirable to resist the tendency of the material to squeeze out from under the compression plate. The total cost of these eight tests, including cost of material and labor, was only $321.

Tests were conducted in positions varying from 12 inches below water level to 18 inches above water level; loads were added by one thousand pound increments and the ultimate settlement for a maximum load of 16,000 pounds after an elapsed time of about 19 hours varied from less than 1/2 inch for test No. 7 made 9 inches below water level, to 2¼ inches for test No. 2 made about 12 inches below water level. The soil was alternate strata of sand and clay of different qualities. The tests indicate the sensitiveness of the apparatus and that the settlements are uniform in character and reveal the elastic nature of the soil.

The essential features of the testing machine are: A bearing plate, compression post, adjusting screw, balance beam, ballast hopper, counterweight, saddle beam with anchorages, and the necessary recording device. They should be used in the following manner:

After erecting the anchorage boxes and saddle beam, the boxes should be filled and the balance beam put in position and balanced, with the hopper in place, by filling in the counterweight box. After excavating a test pit (using breasting boards, if necessary), the bottom should be carefully leveled, and the bearing plate placed in position by plumbing down from the plate on the balance beam. The section of sewer pipe should then be placed and carefully backfilled.

The compression post may then be placed, the screw adjusted, and the recording device attached. This consists of a board, on which is tacked a sheet of paper, and a light straightedge hinged near the edge of the board. A vertical line is ruled on the paper, at some fixed ratio of the distance from the axis of the straightedge to a nail driven in the compression post. At the start, and as weight is placed in the hopper, lines should be drawn along the straightedge and the time and weight recorded. The balance beam should be kept level, as the post is depressed, by means of the adjusting screw.

The hopper may be calibrated and a scale attached for direct reading of the weight. Either dry sand or water may be used, and provision made near the bottom of the hopper for drawing them off. All contact points should be coated with heavy grease.

*Abstract of the progress report of the special committee to codify present practice of the bearing value of soil for foundations, etc., presented to the annual meeting of the American Society of Civil Engineers, January 15, 1922, and published on page 523 of the proceedings, Volume 18, No. 3, March, 1922.

Contractors Boycott Sewer Specifications

The Commissioners of Sewerage for the city of Louisville, Kentucky, invited bids for one million dollars worth of sewers, bids to be opened May 23rd. On that date no bids were presented because the contractors took exception to a clause of the specifications which provides that the commission engineer's estimates and decisions shall be final as regards amount, quality and acceptability of the work, and conclusive upon both parties. The contractors insisted that disputed points should be passed on by an arbitration board and not by the commission engineer representing one party only of the contract.

Later, the contractors, after several conferences with the commission, agreed to execute the orders and directions of the commission's engineer without question provided that their claims for compensation were heard by a jury. This arrangement was accepted by the Commission but the Commission's attorney, William Crawford, refused to revise the contract and specifications and the Commission again proceeded, without eliminating the objectionable clauses, to advertise for bids to be opened June 23rd.

The latest advices indicate that the contractors will again refuse to bid and they have requested the Commissioners of Sewerage to join them in asking the courts, under the new Declaratory Judgment law, to interpret the objectionable clause.

D. R. Lyman, secretary of the Kentucky Association of Highway Contractors, has given full publicity to the statement that the contractors' fight is against unfair conditions and if sucessful, will be beneficial to both the contractors and the general public and that Kentucky asks and expects to receive the national co-operation of contractors.

Street Cleaning Performance and Cost Data

By Zara Witkin*

Advantages of linear performance units over present areal units in securing accurate data

Accurate performance records would furnish a tremendous stimulus to more efficient street cleaning. They would permit significant work and cost comparisons which are the bases of progress in any field. To develop such records, performance units must be employed which accurately represent the work actually done. The present type of areal units does not do this, and often tends to mask the performance instead of evaluating it.

A considerable amount of energy is spent in deploring the lack of accurate street cleaning performance records and cost data available for comparative purposes. This "deploring" energy will be much better utilized when transformed into "exploring" energy. Exploring actual methods of street cleaning reveals possibilities for greater accuracy by the use of *linear* units of performance. While street surfaces are areas, and cleaning is assigned to be done on these areas, the various cleaning methods take the form of *linear motion along a street,* and a more rational measure of the work is therefore obtained in terms of such linear distance swept or flushed, etc., as the case may be.†

It is suggested that records of the same performance be kept in both areal and linear units for comparison. Observations of this kind have shown greater consistency for the linear units. It is believed that further tests will demonstrate their superior adaptability.

The use of such units supplemented by data on the conditions and quality of service would establish comparative performance and cost data of wide application and considerable value.

Certain descrepancies between actual performance by various street cleaning methods and the usual records of the work are shown below as compared with the advantages of the proposed linear records.

The Present Unit of Performance

The usual method of recording a street cleaning performance is in terms of the number of thousand square yards cleaned. This is computed by taking the entire area of the street from gutter to gutter for the length over which cleaning is done. The areal unit is applied to all types of cleaning services, including hand sweeping, machine sweeping, hand flushing, machine flushing, squeegeeing, and vacuum cleaning. What the area really means is the *area assigned for cleaning.* It is usually very different from *an areal measure of cleaning done.*

Discrepancies in Recording Quantity of Work Done by Different Cleaning Methods in Areal Units

General Conditions.—The distribution of dirt on a street follows certain general laws. The amount on the central area is very small compared to the amount in the gutters. Usually the wind and the suction effect of traffic are major causes of this difference. Where there is a prevailing wind, one gutter is 'heavier' or dirtier than the other. Therefore, on any given street, irrespective of the absolute amount of dirt, the relative work of cleaning one square yard of area in the center is very different from that involved in cleaning a square yard of gutter area. Summing up a combination of such widely differing dirt areas on the same street produces a total of questionable meaning.

Methods.—1. Hand sweeping, whether done by gangs or by blockmen, in actual practice never covers the entire area of the street but is confined to sweeping the gutters with occasional pick-ups of dirt deposits in the central area of the street. The width of the gutter strip swept usually varies from one to six feet. The implication that hand sweeping is done on the entire area of the street is quite contrary to fact.

The width of a street, which has little influence on the amount of actual work required to clean the street, nevertheless considerably affects *the amount of work which the records indicate as performed.*

2. In machine sweeping, either horse-drawn or motor-driven, the service sometimes performed by this equipment is the sweeping of gutter strips wider than in the case of hand sweeping, but excluding a considerable part of the central area of the street.

3. Vacuum cleaning, where employed, does not always cover the entire area of the street, and is then supplemented by gutter sweepers or gutter sweeping machines. In this case it is sometimes the practice to give complete credit to the main machine for the entire area cleaned.

4. The effect of areal units as used in the customary manner to describe the performance of flushing equipment, is frequently misleading, the actual service being very difficult to determine from the records. Flushers may make from one to four, or even more trips over a single length of street, with the corresponding variations in cost, time and cleaning service, but the usual record will show the same number of square yards "flushed" for both extremes and all intermediate amounts of service.

Different Cleaning Methods Do Not Do the Same Work.—It must further be borne in mind that the services of various kinds of equipment and manual cleaning are not strictly comparable. They are in some cases supplementary and rarely do similar work. For instance, hand sweeping removes large fragments, paper, horse droppings, cigar butts, etc. from the surface of a street, but leaves the fine dust untouched. Flushing machines do not remove any dirt completely but force a certain percentage of the fine dirt and lighter fragments into the gutters where some is carried by the stream of water into catch-

* Engineer, San Francisco Bureau of Governmental Research.

† That this type of unit has been utilized to advantage is borne out by the reference made later to the hand-sweeping performance rates of the Chicago Civil Service Commission Report of 1913. W. H. Nanry, formerly Engineering Examiner (now Director) of the San Francisco Bureau of Governmental Research, also used linear units for all street cleaning methods in recording field observations on performance of the San Francisco Street Cleaning Bureau in 1919.

basin inlets and the rest deposited in the gutters. Horse droppings and heavy fragments are not scoured away by flushing machines. Hand sweeping and flushing are, then, supplementary services, and for the highest quality of cleaning should both be applied to a given street surface. Vacuum cleaning removes a larger percentage of fine dust than does flushing but cannot well be applied to rough, uneven pavement. Machine sweeping is used on relatively dirty streets, but does not remove the fine dust and must be supplemented for thorough cleaning purposes.

These important differences in the services rendered by the various methods of cleaning make indiscriminate comparisons, on the basis of theoretical areas cleaned, of little meaning.

Cost Records

The ordinary "20 cents per thousand square yard" manner of stating street cleaning costs scarcely complies with the principles of compiling cost data.

Including, as it does, the sources of error pointed out above, such a 'unit cost' tells us little more than the statement that *"cloth costs 25 cents per yard"* without adding the kind of cloth, the quality, width, and points of manufacture and delivery. Comparison, for instance, between hand sweeping done in one locality on uneven block pavement by men paid at a certain daily rate, with machine sweeping on smooth pavement by equipment operating at a different daily cost in another locality should not be made without explicitly and fully giving these particulars. The principle of comparison is sound. The weakness is in the scanty records.

The significant elements of cost data in street cleaning methods which should form part of the records are:

1. Labor, daily wage.
2. Length of working day.
3. Price of equipment new, price of replaced parts.
4. Price of unit wear and use (tire mileage cost, gasoline and oil consumption, repair, depreciation, etc.).
5. In case of hired equipment, the rental cost.

These facts light up a cost statement and make it intelligible. With full detail and an accurate record of performance, cost comparisons become of the greatest value.

The Proposed Linear Units

As a basis for accurate records, the use of linear units is suggested.

For hand sweeping, a unit of 1,000 single-gutter-feet or 1 single-gutter-mile swept is useful and practical. The application of this linear work unit was realized, and its principle adopted by the Chicago Civil Service Commission in its investigation of street cleaning in that city in 1913. The report of this study gave the average performance of a hand sweeper in the spring clean-up in *"single-gutter-miles per day."*

Machine sweeping performance similarly is directly expressed by machine-distance, in machine-miles-swept, instead of an area theoretically covered. This linear measure affords direct speed comparison, lost time factors (if proper stop-start time records are kept) and builds up a continuing mileage total on the basis of which, broom wear, depreciation charges, and gasoline and oil costs can be correctly pro-rated.

In stating flusher performance the linear unit is specially applicable. It gives credit to the machine for the actual flushing distance traveled, and for no more. If a 50 foot street is traversed once, and another street, 60 feet in width, is traversed twice, in one flushing, the difference in cleaning service can be readily understood and the relative costs shown. With the general type of record 20 per cent. more work on the 60 foot street would be shown, while actually the increase of work done over the performance on the 50 foot street is 100 per cent.

Hand flushing is practically the only type of street cleaning which cannot be best expressed in terms of linear work units. It is however, a little used method and has little effect on the general discussion.

Squeegeeing and vacuum cleaning machines are similar in use to flushers and the same considerations set forth above for flushers aply to records of their performance as well.

Statement of Conditions Affecting Work

While the general adoption of linear units for street cleaning performance would furnish a definite record of actual work done, these records could be supplemented by other data to indicate the conditions affecting the amount and distribution of street dirt and the quality and effectiveness of the cleaning service. Ordinarily such data are rarely given owing to their wide variations and accidental nature. But every element which can be explicitly stated eliminates just so much from the total of these undescribed conditions. The data for a given street which can be stated so as to reduce the "unknown constant" are:

1. Pavement.—Kind, condition, grade.
2. Traffic.—Density, kind (horse-drawn traffic is the critical value).
3. Presence of car tracks, etc.
4. District.—(Shopping, residential, etc.).
5. Weather.—Dry or rainy.
6. Frequency of cleaning (This is a significant standard of cleanness, since it measures the average time dirt lies on a street before being picked up).

A complete statement of such conditions would permit analysis of comparable performance of street cleaning with respect to the efficiency or organization, men, equipment and methods.

It may be objected that even the full data called for by these proposals would hardly put street cleaning records on a strictly scientific basis and that it is not possible to exactly define such variable and accidental factors as are encountered. This is true. But it is itself a strong argument for the greatest possible precision and systematization in compiling performance records. The whole movement of Scientific Management is based on such an attempt to analyze and codify factors to close approximations which cannot be exactly expressed. Every approach, however, eliminates a part of the uncertainty of the work.

If the peculiar difficulties in street cleaning are accepted as a challenge to engineering analysis, street cleaning practice will steadily advance to efficient, scientific service. The first step is necessarily the development of complete performance records, based on actual linear work units, as suggested above, rendering critical comparisons possible.

Sewer Trenching in Running Sand

Trenching machines likely to involve difficulties from interference with sheeting and bracing. Delayed sheeting or use of towed shield considered. Preliminary sheeting and hand or drag line excavation most promising.

June 6, 1922.

Editor PUBLIC WORKS:
Dear Sir:—

Will you kindly advise me as to the use of any type of excavating machine for sewer work in soil which is all sand, like running sugar when dry, and where it is necessary to shore tightly every inch of the way? The maximum depth is 15 feet and two stories of shoring will probably be used. It is impossible to have the sides of the ditch exposed long in the sun, for then it begins to cut out and fall in; the shoring material must be placed down a little at a time. The width of the trench will be about 6 to 7 feet.

We have always used all hand work on such work due to the conditions, and I am wondering if it is not better in most ways. The banks will positively not stand up without tight shoring. Much of our trench must hug close to curb lines, and be under trees with low hanging branches. The street is also filled with water and gas services.

Will you kindly advise relative to this matter?

Yours truly
City Engineer.

Since the ground is so loose and unstable, the use of excavating machines of the ordinary trench type is very much restricted and is likely not to be practicable. The width of your trench is also about up to the ordinary maximum width of trench machine excavators maknig a single cut and in such unstable soil two cuts would be very difficult or impossible. If the soil is dense enough so that the sides of the full-depth trench will stand up a few minutes after excavation, it may be possible to make a 6-foot cut and immediately sheet it with vertical planks, rangers and cross struts prepared in advance and placed, while driving, behind it.

Cases have been described where trenches were excavated in very loose soil by machines towing behind them a sort of shield moving in the bottom of the trench and affording support and protection for men laying and jointing the pipe as fast as the trench was opened and allowing the sides to cave in or be back-filled immediately after the shield passed. This, however, would imply omission of the sheeting and considerable possible disturbance of the soil adjacent to the trench, which would not be permissible in improved streets.

It is possible that a slight advantage might be secured by plowing along each side of the trench, in advance of the excavation, and filling it with water which, rapidly penetrating the soft sand, might dampen it enough to considerably increase its resistance to sliding for a short time after the excavation was made.

It would be desirable to communicate with the manufacturers of some of the several standard trenching machines such as the Austin Machinery Corporation, Pawling &Harnischfeger, The Buckeye Traction Ditcher Co., Parsons Co., and others who will be glad to give you the maximum dimensions of trench that their equipment will excavate and advise you regarding the efficiency of the equpiment under the conditions that you must encounter. Trenching machines are expensive and bulky and the cost of purchase, transportation and installation is heavy for a small job.

The amount of soil that you have to excavate and the rapidity with which it is required to do the work as well as the obstruction that is permissible in the streets are important factors in determining the methods to be pursued. Unless you can eliminate sheeting and bracing until after a given section of the trench is excavated to full depth, it will probably be inadvisable to attempt to use the ordinary trenching machine and the proposition will become one for most efficient sheeting, excavating, hoisting and back filling.

SHEETING IN ADVANCE

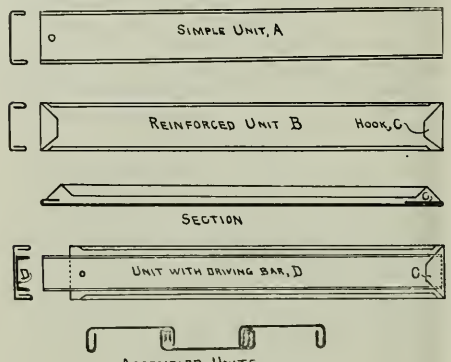
For any considerable amount of work the sheeting should be done in sections long enough to provide for at least two or three days' work and avoid any possibility of delaying the sewer construction and so as to permit as far as possible the transfer of the soil directly from the excavated trench to its final position in back-fill without intermediate storage or rehandling. This will probably mean providing sheet piling for 200 linear feet or more of the trench, which can be pulled in the rear and driven in front so as to use it over and over again as the work advances.

Driving by hand as the excavation is made is slow and costly and with modern facilities it is far better in an important piece of work to drive with power. This can be accomplished either with a sheet pile driving pneumatic hammer or with a hydraulic jet or with both combined. In loose sand a hydraulic jet of from 100 to 200 pounds pressure and a small flat nozzle will sink a 12-inch pile very rapidly and without injury and can easily be operated by a portable pumping outfit driven by a gasoline engine or electric motor. Much wider sheet pile units can be driven with two jets and the work may be facilitated by moderate use of a hand maul.

Two-inch wooden planks may be driven by either the hammer or the jet, but it is difficult to make satisfactory joints between the units and they cannot be interlocked and are liable to be injured by driving, pulling and redriving. Steel sheet piles are much more easily driven because the displacement of material is far less than for wooden piles, they cut through the soil and obstacles more readily, the friction is less and they endure driving better. When properly handled in sandy soil they can be driven and pulled an indefinite number of times without material injury so that at the end of the job they have a high salvage value or are available for storage for future operations.

The sections of steel sheet piles available in the market are most of them heavy and costly for such work. One or two very light sections may be had but must conform exactly to the dimensions of the rolls and of course cannot be secured of extremely light weight or of varying strength and width.

A very efficient pile unit is made of 16-inch gage thickness, from 10 to 15 inches in width and with flanges from 1½ to 3 inches wide as required, will only weigh about 3 or 4 pounds per square foot; is very easily handled and driven, possesses great strength and has an unexcelled interlock, the material all being placed where it is theoretically most effective. The simplest unit is made like sketch A with a pulling hole in one end, and can be driven to a penetration of 10 or 12 feet in loose soil without jetting, but it is better to enforce both ends by bending the web double as in sketch B, greatly increasing the resistance to passing through obstacles and to the impact of the driving hammer.



Slip-joint Sheet Pile Units for Sheeting Trenches

In this case the lower end C is always available to act as a hook and to receive the foot of a channel bar D placed between the flanges of the pile unit and serving as a stiffening bar that enables the pile to be driven through very hard ground or through unexpected obstacles without injury and is afterwards removed and ready for driving the next unit. With this detachable bar, piles up to 15 or 18 inches in width can be driven to considerable depth without injury. By jetting, still greater widths can be used and two jets may be applied if desirable, thus sinking very wide units with or without the detachable stiffening bars. The wider the units the less the probable cost per square foot or per pound and the greater the rapidity of installation. They may be made of very thin sheets as ordered, of any required width and with any required width of flanges and after installation can be faced with loose boards or planks and braced as rigidly as required.

After the sheeting has been driven to full penetration on both sides of the trench the excavation may be commenced by any convenient method. If it is carried on by hand, the spoil can be handled by derricks to trucks or service cars alongside the trench or by cableways for immediate disposition as back-fill; or it may be loaded into buckets and carried along the trench to the back-fill point by some form of conveyor, such as the Potter machine, the Carson trench machine or by a homemade telpher installation.

The only kind of power excavation likely to be efficient in the sheeted trench is a dragline scraper that can be operated, if necessary, under the upper tier of transverse braces that may be installed to support the tops of the sheeting.

Almost any type of standard scraper buckets, such as are made by Saverman Bros., Brown Hoisting Machinery Co., Hayward Co., and the Monighan Machine Co., may be utilized, or one may be improvised and operated with a direct hauling line and tail line handled by a suitable hoisting engine. The loaded buckets may be hauled out of the trench on a movable incline that raises it high enough to dump into a truck at street level or the incline could probably be arranged on a movable platform with a cover protecting the trench so that work could be carried on underneath it and the spoil dumped directly over the finished sewer for back-fill without rehandling.

If gas and water service pipes are located within the limits of the trench, it will probably be more advantageous to excavate by hand rather than attempt to use a power equipment.

Brick Roads in Indiana and Illinois

Contract for construction of the first brick road to be built by the state of Illinois since Governor Len Small's "$30,000 a mile" edict went into effect, has just been let by the Illinois State Highway Department. While smaller political units in the state have been building brick roads right along, this is the first action of its kind on the part of the state highway department, under the present administration.

This follows closely a similar action on the part of the Indiana State Highway Department. Indiana, however, was one of the last states in the union to establish a highway department, and while many miles of brick roads have been built by the various counties in Indiana the recent contract by the state was the first since formation of its highway department.

The Illinois contract, let to J. E. Craine of Murphysboro, Ill., is for 13.32 miles on Route 2, sections 12 and 13, extending from Cobden to Dongola, Ill. Specifications provide for a base of 10 inches of novaculite, laid in two 5-inch courses, a 1½-inch sand cushion, 3-inch vitrified brick and asphalt filler. Curbs of compacted novaculite will be 12 inches wide and 4½ inches deep. The pavement will be 18 feet wide.

"Novaculite" is a trade name of a local material found in Southern Illinois which is a silica product, or what some engineers call disintegrated chert. It contains alumina and oxide of iron, commonly called "clay binder," and when rolled and compacted sets up hard with a cementing characteristic. Like crushed stone, slag, or gravel where available, it is looked upon as a good base material when a rolled base is desired.

The Cobden-Dongola road is a portion of one of the principal north and south highways of the state which, starting at Decatur, runs due south through Pana, Vandalia, Centralia, and Carbondale to Cairo, on the Mississippi river. When completed it will be one of the heavy traffic routes of the state.

In Indiana the recent brick contract was for a 6.89-mile section of the heavily traveled and widely known National Road. There, too, 3-inch brick and asphalt filler were specified.

Recent Legal Decisions

MASTER METER MEASUREMENT OF ELECTRIC ENERGY SUPPLIED BY MUNICIPALITY

The Village Board of Embarrass applied to the Wisconsin Railroad Commission for a revision of its rate and basis of billing for electric energy, sold by the village to a light and power company. The existing practice of the municipal utility was to bill the company at the rate of 8 cents per kilowatt hour on the basis of the reading of individual meters. The board asked that the reading of the master meter be fixed as the basis of billing.

Investigation showed that for five months, the master meter registered 2,910 kilowatt hours, and during the same period the individual meters supplying consumers of the light company registered 1,236 kilowatt hours, indicating a loss of 1,676 kilowatt hours, or 57.6 per cent. Data from six rural companies operating under similar conditions indicated that the weighted average loss was 56.1 per cent during 1921.

The Commission considered that the measurement of energy as a basis for computing the bills to the company should be made at the master meter, as requested by the municipality, but the characteristics of the load on this line where a very substantial part of the energy is lost in transformers make the service, in the commission's opinion, entitled to the regular power rate of the village, or 5 cents per kilowatt hour.

VALUATION OF UTILITY PLANT FOR MUNICIPAL PURCHASE

The California Railroad Commission, in proceedings for the acquisition by the city of Redding of an electric distribution system, that items of "appreciation in value," due to increased market prices, entering into the valuation of the plant since its valuation for municipal purchase, or into the allowance of severance damages, are not allowable under the provisions of the California Public Utilities Act.

CANCELLATION OF ROAD CONSTRUCTION CONTRACT DOES NOT RELEASE FROM PAYMENT OF BOND PREMIUM

The Indiana Appellate Court holds, Rehm v. McCray, 134 N. E. 505, that the action of a county board of commissioners in releasing a contractor for road construction and canceling his contract after accepting his proposal did not release the contractor from his agreement with the bonding company to pay the premium for the bond submitted, as required by statute, with his bid.

CHANGING CONTRACT RATES FOR WATER—VALUATION FOR RATE-MAKING

The Indiana Public Service Commission, in the case of the Sullivan County Water Company, holds that it has authority to change the rates of a water company, notwithstanding the fact that a city from which the company acquired the plant by purchase has contracted with it for certain maximum rates as a consideration of its transfer of the property, although the contract was made prior to the passing of the Public Service Commission Act. The Commission also holds that property which the water company now has in use for public service must necessarily be considered in finding a rate base, even though property was obtained from the city, and the purchase price left partly unpaid, if such be the case, since the Commission does not concern itself with the question whether the consideration originally paid for any property was adquate or inadequate.

ORAL CHANGE OF CONTRACT TO FURNISH STONE HELD VALID

A city having contracted with an engineering company to build certain streets, the company contracted with a subcontractor to furnish the stone according to plans and specifications of the city, made part of the contract. The principal contractor subsequently agreed with the city to make changes in the contract which necessitated changes in the stone. In an action by the subcontractor against the principal contractor and the city, it was alleged that the changes were made with the understanding that the plaintiff was to receive extra compensation for the extra expense of furnishing different stone from that specified in the contract, and that the plaintiff notified the city of its claim against the principal contractor before the city settled with the latter. The contractor denied the agreement for additional compensation and set up a counterclaim because it had to go into the open market at an increased price when the plaintiff's plant broke down. The jury found for the plaintiff in the full amount of its claim, deducting the defendant's counterclaim. On appeal, judgment for the plaintiff was affirmed, the change in the contract being competent though it varied a written contract, as it was made subsequent to the original contract. And, the company having accepted the stone, it was held chargeable for its value even if there was no express promise. J. E. Lane & Co. vs. Central Engineering Co., North Carolina Supreme Court, 111 S. E. 344.

SECURITY FOR LABOR AND MATERIALS FOR MUNICIPAL PUBLIC WORKS

Massachusetts St. 1920, c. 210, requires that, in order to obtain the benefit of security held by a city, town or county to pay for labor performed or material and labor supplied in the repair or construction of a public building or public works, a sworn statement of the claim shall be filed in the town clerk's office within sixty days after the plaintiff ceases to perform labor or ceases to supply labor and material. The Massachusetts Supreme Judicial Court holds, Brockway-Smith Corporation vs. Robert A. Boyle Co., 135 N. E. 136, that in order to avail oneself of the remedy given by the statute, it must be strictly complied with. To establish a lien upon security held by a town, the petitioner must show that he had complied with the statutory provisions, and filed with the town clerk within sixty days after he ceased work sworn statement of his claim. And although a contract with a town for the construction of a building was executed before the taking effect of the 1920 act, a contractor who ceased to furnish labor and material in July, 1920, when the statute was in force, was bound to comply with the statute in order to have the benefit of the security.

NEWS OF THE SOCIETIES

CALENDAR

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1 — AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

July 12-14—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Exhibition. Auditorium Bldg., Springfield, Mass.

Aug. 15-18—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Fiftieth convention. Municipal Auditorium, San Francisco, Cal. Secretary, James J. Mulcahey, Chief, Yonkers, N. Y., Fire Dept.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 12-15—NEW ENGLAND WATER WORKS ASSOCIATION. 41st annual convention. New Bedford, Mass. Secretary, Frank J. Gifford, Tremont Temple, Boston, Mass.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 1-6—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19 — AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Clevelnd, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beck, Chicago.

Dec. 7-12—NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. New York City.

AMERICAN ASSOCIATION OF ENGINEERS

The Eighth Annual Convention of the American Association of Engineers met in Salt Lake City, Utah, on June 5, 6, and 7. Discussion was centered on policies for the ensuing year, problems affecting engineers, and methods of perfecting the usefulness of the Association and the profession to the public. Three days were devoted to discussion of these broad problems and action was taken as follows:

The reclamation of arid and swamp lands was endorsed and also the Smith-McNary Bill now pending before Congress.

The appointment of an engineer executive on the U. S. Civil Service Commission was urged and A. B. McDaniel recommended for appointment.

Prompt action by Congress on the bill to aid federal employes (H. R. 8928) was recommended.

An official statement of the policies of the Association to railroad executives was authorized to acquaint them "with the real objects of the A. A. E., the betterment of the conditions of the engineer, the education of the public as to the dignity and importance to civilization of the profession of engineering, and that the best interests of the profession, as such, call for loyalty to, co-operation with, and devotion to the interests of the client or employer. whether corporate or individual."

Action by Congress to relieve the labor shortage in Hawaii was urged and support of Joint Resolution 171 H. R. recommended.

In developing policies and methods for making the Association and the profession of greatest usefulness in the life of the average American:

Service to special classes of engineers was recognized and urged by the Association as a whole rather than by action as classes.

Close co-operation with business clubs was urged and provided.

Provision was made for support of work of local units by granting them 40 or 60 per cent. of the annual dues, depending on the amount of work undertaken by the local units.

Provision was made for the development of a comprehensive employment service under the supervision of the Board of Directors.

There was considerable rivalry as to where the next convention should be held, and it was recommended that the following cities receive consideration for coming conventions: 1923—Norfolk, Va.; Atlanta, Ga.; Louisville, Ky.; Columbus, O.; 1924—San Francisco, Calif.; 1925 — Portland, Oregon; 1926—Philadelphia, Pa.

H. W. Clausen, Treasurer, reported that the total income of the Association from all sources for the period from May 1, 1921 to April 30, 1922 was $218,176.84; of this amount $113,-067.98 was returned to the chapters for local work.

Standing committee reports were read as follows: "Qualifications"; "Practice"; "Administrative Board of Professional Engineer"; "Chapter Activities"; "Political Activities;; "Railroad Committee" "Classification of Engineering Schools" "Education" "Services and Fees" "Legislation" "Employment," K. H. Talbot. Mr. Talbot referred briefly to the work accomplished in assisting members to find suitable employment, particularly during the period of depression. He stated that 7,340 applications for employment were received in 1921 and 2,751 men were placed. On an average, the members changed their addresses once in two years.

The discussion of methods to be used in local work were led as follows with A. B. McDaniel as chairman: "Principles of Chapter Success," G. R. Fansett; "A Standard Chapter Constitution," delegates of Maryland and Delaware; "How to Rate Your Chapter," W. G. Ruegnitz; "Local Civic Responsibility," W. H. Scales; "Chapter Bulletins and News Service," A. J. Capron; "How To Do Chapter Work," H. H. Allen; "Obtaining and Holding Members," Will P. Blair; "Publicity and Public Affairs," W. W. DeBerard; "Conducting Chapter Meetings," E. T. D. Myers; "How to Make Officers Function," T. A. Dungan; "How to Arouse and Sustain Membership Interest," A. M. Knowles; "How to Assist National Headquarters in Collecting Dues," T. A. Dungan; and "The Sphere of Women in Chapter Activities," B. W. Matteson.

The Ogden Chapter was awarded a banner for excellence in public information work during the past year. The convention was addressed by J. D. Broaddus, who delivered an illustrated lecture on scenic Utah; H. J. Grant, President of the Latter Day Saints' Church, spoke at the banquet; and Virgil E. Rorer, D.D., pastor of the Meridian Street Methodist Episcopal Church of Indianapolis, spoke on Americanism, calling attention to the importance of Americanization work.

The convention delegates were royally entertained by the Salt Lake City Chapter of the Association with C. J. Ullrich as chairman of the Entertainment Committee. There was a dance, a smoker, a banquet, an organ recital at the Latter Day Saints' Tabernacle, a plunge in Salt Lake followed by a supper, and many automobile trips to points of interest, including the enormous workings of the Utah Copper Company.

The officers elected were: President, A. N. Johnson, Dean of Engineering, University of Maryland, College Park, Maryland; First Vice-President, Geo. E. Taylor; Second Vice-President, A. M. Knowles; Directors, W. S. Boyle, Wythe M. Peyton, C. A. Poole, F. C. Shepherd, H. C. Ferry.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The June Outing, to Providence, R. I., and vicinity, June 27, will be a personally conducted 45-mile automobile tour of Rhode Island, including a Shore Dinner at Rocky Point, on Narragansett Bay, and a visit to Scituate Dam, under construction for the past year and now at an interesting stage.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The thirty-eighth annual convention of the American Institute of Electrical Engineers will be held in Niagara Falls, Ont., on June 26-30, 1022, with the Clifton Hotel as headquarters. The technical program is made up of five main groups of papers and in addition several papers on a variety of subjects, ranging from pure physics to practical mechanical engineering. These groups, briefly stated, are: The New Queenstown Plant; Standards of Rating of Generator Insulation; The Baltimore Oil Circuit Breaker Tests; Symposium

(Continued on page 470)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HUG TRUCK TURNTABLE

This equipment, manufactured by the Hug Company, was designed for contractors' use in accordance with a realization of their needs gained by several years' experience in road building. It turns a loaded truck on the truck's own power; protects the subgrade; requires no tracks; occupies only 7½ foot width on road; can be moved by two men; speeds up the job; requires fewer trucks; eliminates delays; provides more yardage.

For operating the turntable, drive on it in low gear and bring truck to stop when right hand wheel strikes the bumper on turntable. Start up truck on low gear, engaging clutch slowly.

By turning and locking wheels turntable can be easily moved ahead to new position by two men. The turntable being light, can thus be kept close to the work, thereby reducing the distance trucks must be backed to deposit load.

Carried in stock in two sizes, for Ford ton trucks, weight 600 pounds, $330; for 2½-ton trucks, 112 to 120-inch wheel base, weight 700 pounds, $440; special sizes built to order.

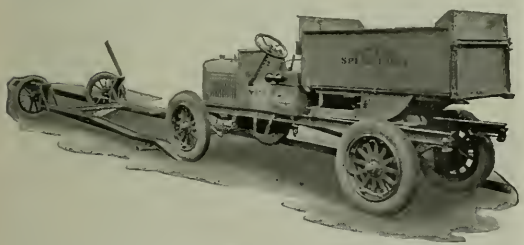
With the Buda "Buddie" power plant and Werner gear transmission with a gear ratio of 4.84 to 1 on low, and a Clark bevel gear axle with a gear ratio of 5-1/2 to 1 on high, the Hug is believed to meet all conditions encountered on a road job. It speeds up on good roads and pulls and digs itself out through soft and spongy spots due to the low gear ratio in the transmission.

The special dump body will hold a six-bag batch of mixed concrete.

An analysis of actual performance of hauling mixed concrete one mile from machine to slab shows that the Hug machine averaged 56 trips in 10 hours while a one-ton truck averaged only 40 trips in 10 hours, showing an increase of efficiency of 35 per cent. in speed for the Hug truck and 50 per cent. in capacity over the one-ton truck.

The truck has a capacity of 4,000 pounds, chassis weight of 3,400 pounds, wheel base of 120 inches, and a road speed of 45 miles per hour. The Hug truck used with a 6-sack mixer on an 8-day test averaged 960 linear feet of concrete pavement at a labor cost of $913.92 for one mile which was completed in 5.44 days in comparison with a labor cost of $1,386.00 per mile completed in 8.25 days with 10 4-ton trucks and a 4-sack mixer. This showed a saving of $472.00 on payroll cost, $110.00 on gasoline cost, $220.00 on truck rental, $25.00 on plant equipment and $25.00 on overhead expenses, making a total of $852.00 or 8 cents per square yard of pavement made. The longer the haul, the greater the saving. Records of service of Hug trucks show hauling mixed concrete at an average speed of 20 miles per hour, hauling bricks 17 miles over dirt road in 50 minutes, and 20 miles in 45 minutes over concrete roads. In doing the work, the truck was run about 10,000 miles without repairs.

THE HUG TURNTABLE, USED ON SUBGRADE, AND TURNING LOADED TRUCKS BY THEIR OWN POWER.



HUG SPEED TRUCK MOUNTING HUG TURNTABLE.

HUG SPECIAL SPEED TRUCK

This truck, manufactured by the Hug Company, was built after several years of road building experience by C. J. Hug, who realizing the need of a truck especially adapted for this service, designed and constructed an experimental truck for use on his own road contracts. Its remarkable performance under actual working conditions, its economy of time and money, and its practical service led to its commercial production.

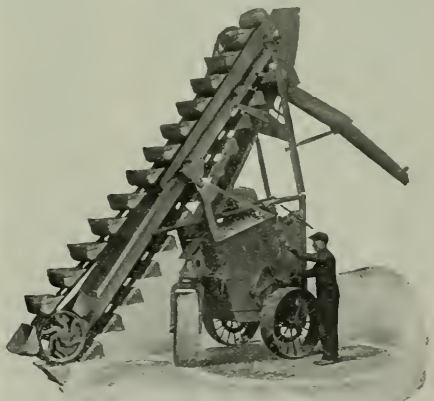
JEFFREY RADIAL TYPE LOADERS

The Jeffrey Radial Loaders, made by the Jeffrey Manufacturing Co., have been developed by over ten years' experience in designing and building self-propelling loaders for the handling of sand, gravel, crushed stone, coal and other loose materials from ground storage, and have eliminated the former inability of this class of machine to feed into the stock or storage pile.

In this machine the elevator is mounted upon a three-wheel chassis, and buckets are wider than the elastic boom, which features allow the machines to advance 8 to 10 feet into the stock pile without any cleaning up.

The three-wheel radial loader is more convenient than the four-wheel type and will turn in a smaller circle around either drive wheel as a center. It will turn short corners and can be propelled in any direction as readily as a wheelbarrow. Elevator buckets are provided with renewable digger edge steel teeth.

A large dribble chute catches all the spill and returns it to foot of elevator. The long flexible spout enables the operator to properly distribute the truck load without hand trimming. The elevator boom is quickly adjustable without loosening a bolt. The collapsible fea-



JEFFREY RADIAL TYPE LOADER, SHOWING THE SMALL RADIUS IN WHICH IT WILL OPERATE.

ture makes it possible to ship the machine completely assembled.

Both elevator and self-propelling mechanism are through friction clutches which may be operated simultaneously or independently of each other. The driving wheels are fitted with roughing cleats. The machine is equipped with either an electric motor or a gasoline engine.

All controlling levers are handy and easily moved from a single operator's position. The machine is operated by one man and does not require skilled labor. The boom can be readily adjusted to clear ground or any obstruction. The radial loader saves the labor of 5 to 10 men and handles more material in the same time besides cutting down the waiting time of trucks.

The type "K" loader has a rated capacity of 1 cubic yard per minute; will load a 5-ton truck in 8 to 10 minutes; will handle 2½-inch crushed stone and coal up to 6 inches. The propelling speed of 60 feet per minute for traveling from pile to pile and digging speed of 4 feet per minute, are independent of the elevator. The shipping weight is 5,500 pounds with motor and 6,000 pounds with engine.

The type "G" loader is designed for heavy service. Its capacity is 1½ to 2 cubic yards per minute of sand, gravel, crushed stone, coal, cinders and similar loose materials, and it is high enough to load any type of truck. It has a fast speed of 40 feet per minute for traveling from pile to pile and a slow speed of 2 feet per minute for feeding into the material. The shipping weight is approximately 8,500 pounds.

THE DUNN ROAD BUILDER

The Dunn Mile-a Week Road Builder, manufactured by The Dunn Road Machinery Company, replaces the hand tamper and float, and although it came into general notice for the first time at the Road Show at Chicago, last January, it was invented some years ago. It was first used for tamping and laying base courses for monolithic brick roads. This method of laying brick roads and pavements was developed by the Dunn Wire-Cut Lug Brick Company, and has come into widespread use.

Mr. Dunn and other officers of this company organized the Dunn Road Machinery Company, bought the patents and took up the manufacture of this machine. Notwithstanding that several machines had already been built and put into use and are still rendering good service, thus showing that its operating principles were fundamentally sound, engineering talent was secured and the machine was redesigned for operation on all kinds of road work. Every change was carefully tested out in actual concrete road work by experienced highway engineers and contractors to insure a machine which fills every requirement for first class service which is constructed entirely of metal, almost eliminating upkeep.

It will tamp and finish concrete roads, either of the regular type or two-course concrete pavements, and it will finish base courses for other types of surface. It has adjustments at all required points to make it universally adaptable to roads with various crowns and for handling all kinds of mixtures and aggregates. All the tamping members have a positive stroke and can all be adjusted to penetrate the concrete to a predetermined depth.

The concrete in addition to being struck off and leveled in two stages by the auxiliary strike-off and the main strike-off is also operated upon by three separate tamping members; first, by the clearing tamper, which running at a comparatively slow speed, drives the larger pieces of gravel or crushed stone down a slight amount below the finished surface; second, by the spader, which is a ⅜-inch blade running at about 130 strokes per minute, and is so timed in relation to the forward motion of the machine that each blow on the concrete laps the area covered by the previous blow by about half the thickness of the blade, or in other words it actually strikes all portions of the surface twice. The third working operation is done by the tamper, which is a 4-inch channel with the flanges turned up, and is so set that the extremity of its stroke is even with the form and which practically finishes the road. It actually does so, on base course work, but when working on finished concrete the slight variations in the mortar are smoothed out by the finishing belt, which is automatically moved back and forth across the road, with a five-inch stroke.

All the tamping or working operations are such as to secure great density of the concrete without any repetition of the work to cause a separation of the coarse and fine material, or of raising an undue amount of mortar to the surface. The machine travels over the work only once, consequently there is no possibility of breaking the bond on partly set concrete.

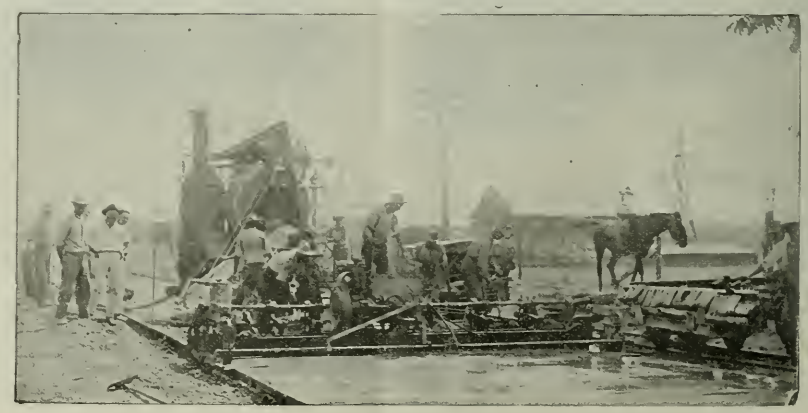
The method of propulsion is altogether different from that of any other machine. There are two drums mounted on the forward end of the machine and driven by means of miter and worm gearing. On each drum there is wound a steel cable, the loose ends of which are attached to angle iron stakes driven into the ground on both sides of the road from 100 to 200 feet ahead of the machine. The drums are independently driven by clutches under the operators' control, and on account of the large speed reduction at the drums, exert a tremendous pull. This means that the condition of the rail or road form surface on which the machine runs is of no consequence as far as propulsion of the machine is concerned. There are, however, scrapers mounted in front and in the rear of each of the four wheels to insure a perfectly smooth finish on the road surface.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

(*Continued from page 467*)

on Engineering Education; Papers on Miscellaneous Subjects and Insulation and Rating of Electric Cables.

Entertainments and convention trips have also been liberally arranged for and will take in many points of interest which abound in the locality.



THE DUNN MILE-A-WEEK ROAD BUILDER FINISHING CONCRETE PAVEMENT.

Advance Contract News

ADVANCE INFORMATION

ITEMIZED PRICES

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information concerning it as early as possible; also correction of any errors discovered.

BIDS ASKED FOR

STREETS AND ROADS

Conn., Norwalk **2 p.m., June 24**
For pav. 3,150 0sq. yds. cem. conc. rd.—C. L. Barton, Mayor.

Conn., New Haven **10 a.m., June 27**
For pav. sts.—Edw. S. Nettleton, City Engr.

D. C., Washington **June 26**
For asph. surf. sts.—Dist. Comrs., Dist. Bldg.

Fla., Clearwater **S p.m., June 28**
For pav. with brk. and asph. blk., drain. and grad. various sts.—J. R. Thomas, City Clk.

Fla., Quincy **4 p.m., July 18**
For pav. with curb., gutters and const. sewers, etc.—City Council.

Fla., Tallahassee **June 27**
For surf. 17.87 mi. on 2 rds.—St. Hgwy. Dept.

Ind., Angola **2 p.m., July 3**
For impv. H. L. Smith Rd., $96,619—Frank O. Watkins, Co. Aud.

Ind., Cannelton **1 p.m., July 3**
For impv. Dan Gayer et al rock rd., $34,944, and Jacob Hausen et al rock rd., $20,056—T. A. Lasher, Co. Aud.

Ind., Crawfordsville **10 a.m., July 5**
For impv. 5.466 ft. Wm. Kirkpatrick et al rd., $4,931—Ward McClelland, Co. Aud.

Ind., English **2 p.m., July 6**
For const. Amos Mocheler et al, Louis J. Gast, A. L. Pierce and Wm. F. Sommers et al rds.—B. H. Kinne, Co. Aud.

Ind., Indinnapolis **10 a.m., June 28**
For curb., grad., pav. and resurf. sts.—Bd. Pub. Wks.

Ind., Monticello **10 a.m., July 5**
For M. B. Spencer Rd., 6,720 ft., $10,-512—F. B. Vinson, Co. Aud.

Ind., Pnoli **2 p.m., July 5**
For const. Part Orleans and Liberty Rd., French Lick and Norton Rd., 12,174 and 3,981 ft. respv.—P. M. Stephenson, Co. Aud.

Ind., Shelbyville **10 a.m., July 5**
For impv. 5,330 ft. Warren Buck, 9,446 ft. Melvin Havens and 5,625 ft. Jacob Schuck rds., gravel—Walter W. Leslie, Co. Aud.

Ind., Indianapolis **June 30**
For pav. 2.55 mi. rd., conc., $86,252.—Co. Comrs.

Ind., Bedford **1 p.m., July 10**
For const. gravel or mac. rd. on Co. line bet. Lawrence and Orange Cos.—Wm. M. Denniston, Co. Aud.

Ind., Fort Wayne **10 a.m., July 11**
For impv. 3 mi. Eby Rd., $76,800—Angus C. McCoy, Co. Aud.

Ind., Indianapolis **10 a.m., July 5**
For const. 3.533 mi. F. A. 32, Sec. A-C—J. D. Williams, Dir., St. Hwy. Com.

Ind., Kentland **1 p.m., July 3**
For impv. 3 mi. Shaw Rd., gravel—John G. Davis, Co. Aud.

Ind., Shoals **2 p.m., July 3**
For const. 3 county unit rds., 7,439, 19,008, 18,383 and 17,765 ft. long—Bertie L. Newland, Co. Aud.

Ind., Indinnapolis **2 p.m., June 26**
For grad. and pav., also resurf. rdways—Bd. Pub. Wks.

Ind., Versailles **1 p.m., July 3**
For const. Geo. Sparling et al. free conc. rd., 10,736 ft.—W. D. Robinson, Co. Aud.

Ind., Madison **1 p.m., July 5**
For impv. Frank D. Spann et al rd., 15,680 ft., Edwin C. Reed et al rd., 13,-200 ft., John H. Gray et al rd., 2,700 ft., Geo. F. Silver et al rd., 10,740ft., and John B. Corya et al rd., 15,485 ft.—Chas. S. Dibler, Co. Aud.

Ia., Atlantic **1.30 p.m., June 26**
For const. prim. rd., F. A. Proj. No. 155—Co. Aud.

Ia., Dakota City **1. 30 p.m., June 30**
For grav. surf. F. A. Proj. No. 117—Co. Aud.

Ia., Onawa **3.30 p.m., June 26**
For grad. 2½ mi. prim. rd., Proj. No. 38, Sect. D—Co. Aud.

Ia., Pocahontas **1.30 p.m., June 27**
For grad. and incidental work on Sect. Z, Pocahontas-Gilmore Rd.—Co. Aud.

Ia., Washington **1 p.m., June 29**
For grad. and drain. 16.35 mi. prim. rd., F. A. Proj. No. 167—Co. Aud.

Kans., Osawatomie **2 p.m., June 30**
For pav., grad., and guttering driveways in park—Bd. Trustees, John Brown, Memorial Park.

Kans., Troy **July 7**
For grad., bridging and pav. 7.844 mi. F. A. Projs. 116 and 87.—H. L. Parker, Engr.

Ky., Paris **July 5**
For pav. Main St.—J. W. Hayden, City Clk.

Ma., Forsyth **2 p.m., June 27**
For impv. 2.434 mi. Proj. 20.150—C. W. Brown, Act. Ch. Engr., St. Hwy. Com.

Mass., Boston **noon, June 27**
For granite block pavt. in South Boston, and sh. asph. or bitul. pavt. in city proper—Jos. A. Rourke, Comr. Pub. Wks.

Mass., Boston **noon, June 28**
For sh. asph., bitul. and granite block pavt. in Roxbury and sh. asph. or bitul. pavt. in Charlestown—Jos. A. Rourke, Comr. Pub. Wks.

Mass., Boston **1 p.m., June 27**
For const. 6,950 ft. bit. mac. rd. in Ayer and Shirley, 600 in Ashland and 3,400 in Action—A. W. Dean, Ch. Engr., Div. Hwys., Dept. Pub Wks.

Mich., Bessemer **10.30 a. m., July 7**
For impv. 3.299 mi. St. Trunk Line Rds. Nos. 2-24 and 12-23—F. F. Rogers, St. Hwy. Comr.

Mich., Escanaba **10.30 a. m., June 30**
For impv. 1.387 mi. St. Trunk Line Rd. No. 35-9, and 13.261 mi. F. A. Rd. No. 25, Sect. A, and St. Trunk Line Rds. No. 12-2 and 12-4—F. F. Rogers, St. Hwy. Comr.

Mich., Houghton **11 a.m., June 29**
For surf. treat. 4.056 mi. St. Trunk Line Rds. 26-3 and 26-8, Sect. B—F. F. Rogers, St. Hwy. Comr.

Mich., Jackson **1 p.m., July 6**
For impv. .396 mi. rd. and const. substructure for undercrossing passing under tracks—F. F. Rogers, St. Hwy. Comr.

Mich., Sandusky **1 p.m., July 11**
For impv. 1.241 mi. St. Trunk Line Rd. No. 27-18—F. F. Rogers, St. Hwy. Comr.

Mich., Dearborn **S p.m., June 24**
For const. conc. pavt. and curb on sev. sts.—Herman B. Knauff, Vil. Clk.

Mich, Grand Rapids **9 p.m., July 6**
For impv. 2.564 mi. St. Trunk Line Rd. No. 13-16.—F. F. Rogers, St. Hgwy. Comr.

Mich., Iron Mountain **2 p.m., July 6**
For impv. 4.945 mi. St. Trunk Line Rd. No. 12-36.—F. F. Rogers, St. Hgwy. Comr.

Mich., L'Anse **10:30 a.m., July 12**
For impv. 9.344 mi. St. Trunk Line Rd. No. 69-4.—F. F. Rogers, St. Hgwy. Comr.

Mich., Munising **10:30 a.m., July 5**
For impv. 2.034 mi. St. Trunk Line Rd. No. 25-14, Sect. A.—F. F. Rogers, St. Hgwy. Comr.

Mich., White Pigeon **1:30 p.m., June 29**
For impv. 6.367 mi. F. A. Rd. No. 66, Sect. A.—F. F. Rogers, St. Hgwy. Comr.

For resurf., and pav., $28,000.—C. A. Poole, City Engr.

Mich., Cadillac **1.30 p.m., June 30**
For impv. 3.729 mi. St. Trunk Line Rds. Nos. 22-14 and 22-4, Sects. A and C.—F. F. Rogers, St. Hwy. Comr.

Mich., Grand Huven **1.30 p.m., June 27**
For impv. 4.560 mi. St. Trunk Line Rd. No. 16-5.—F. F. Rogers, St. Hwy. Comr.

Mich., Maniastique **10.3 0a.m., June 27**
For impv. 17.544 mi. St. Trunk Line Rds. Nos. 12-30, 12-12, 12-17 and F. A. Rd. No. 25, Sect. B.—F. F. Rogers, St Hwy. Comr.

Mich., Jackson **9 a.m., June 29**
For impv. 2.919 mi. F. A. Rd. No. 75, Sect. B—F. F. Rogers, St. Hwy. Comr.

Mich., Harrison **1.30 p.m., June 28**
For impv. 1.937 mi. St. Trunk Line Rd. No. 20-11, Sect. B.—F. F. Rogers, St. Hwy. Comr.

Mich., Marshall **1.30 p.m., June 30**
For impv. 2.302 mi. F. A. Rd. No. 29, Sect. B and St. Trunk Line Rd. No. 17-1—F. F. Rogers, St. Hwy. Comr.

Mich., Sault Ste. Marie
10.30 a.m., June 28
For impv. 9.060 mi. St. Trunk Line Rds. Nos. 48-6, Sect. A, 48-10 and 48-5, Sect. A—F. F. Rogers, St. Hwy. Comr.

Mich., Traverse City **1.30 p.m., June 27**
For impv. 1.269 mi. St. Trunk Line Rd. No. 11-12, Sect. B—F. F. Rogers, St. Hwy. Comr.

Minn., Barnesville **9 p.m., June 24**
For 1 mi. rd. in Atherton Twp.—C. W. Williams, Town Clk.

Minn., Duluth **1.30 p.m., July 10**
For road work on F. A. Proj. 183, St. Jobs 2005 and 2110—W. H. Borgen, Co. Aud.

Minn., Faribault **July 10**
9 a.m., gravelling Job No. 2109; 10 a.m., grad. 4¾ mi. St. Rd. No. 26; 2 p.m., grad. 2 mi. Job No. 22-06; 4 p.m., grad. 2 mi. Job No. 22-07—Frank M. Kaisersatt, Co. Aud.

Minn., Hastings **June 26**
For relay., rebldg. and partial const. of new sidewalks—N. F. Kranz, City Clk.

Minn., Mantorville **2 p.m., July 10**
For grad. const. of Job 2204, St. Rd. 3, and const. bridge—Geo. L. Taylor, Co. Aud.

Mo., New London **9.30 a.m., June 26**
For impv. 3.829 mi. Proj. 20.16S—C. W. Brown, Act. Ch. Engr., St. Hwy. Com.

Mo., Poplar Bluff **11 a.m., June 24**
For impv. 8.435 mi. Proj. 58-C, 8.526 mi. Proj. 58-B and 7.266 mi. Proj. 58-A—C. W. Brown, Act. Ch. Engr., St. Hwy. Com.

Mo., St. Lonis .... **noon, July 11**
For impv. cert. sts. by pav., curb., etc.—E. R. Kinsey, Pres., Bd. Pub Serv.

Neb., Lincoln **10 a.m., June 24**
For const. pav. and repav.—Theo. H. Berg, City Clk.

N. H., Concord **2 p.m., June 30**
For 0.8 mi. bit. mac. rd. on stone base in Sunapee, incl. 2 24-ft. span rein. conc. bridges—F. E. Everett, St. Hwy. Comr.

N. J., Glen Ridge **S p.m., June 26**
For excav. 4,000 cu. yds. earth for rdway—John A. Brown, Boro Clk.

N. J., Newark **10.15 a.m., June 28**
For resurf., const. conc. curb and gutter, rebldg. storm sewer—Geo. C. Bergen, Co. Purch. Agt.

N. J., Newark **10.15 a.m., June 26**
For repav. on sides of tracks—Thos. L. Raymond, Dir., Dept. Sts. & Pub. Impvs.

N. J., South Orange **S p.m., June 30**
For impv. cert, sts. by curb., sidewalk, pavt., sewers, etc.—Geo. H. Beeler Chn. Bd. Vil. Trustees.

N. J., Long Branch **S p.m., June 27**
For pav. 18,000 sq. yds. asph. on conc. found. with conc. gutters, etc.—Frank C. Quinn, City Clk.

N. J., Ridgefield Park **5 p.m., July 5**
For conc. rd. const.—M. D. Starker, Vil. Clk.

N. J., Toms River **11 a.m., July 7**
For const. Route 4, Sects. 17 and 18 on st. hwy.—Bd. Chosen Freeholders.

N. J., West Orange **8.15 p.m., June 28**
For lay. conc. curbs and pav. with bitum. pavt.—Henry C. Warnick, Town Engr.

N. Y., Buffalo **11 a.m., June 26**
For elimination of grade crossings, incl. const. rd. bed and all track work—Grade Crossing Com., 436 Ellicott Sq.

N. Y., Rouses Point **7 p.m., June 27**
For st. impv., incl. 1½ mi. bit. mac. and 1,150 ft. curb.—A. G. Carriere, Vil. Clk.

N. Y., Fredonia **June 26**
For pav. cert. sts., $40,000.—Bd. Trustees.

N. Y., Massena **8 p.m., June 26**
For st. pav. on cert. sts.—W. E. Timmerman, Vil. Engr.

N. Y., Victor **8 p.m., June 24**
For impv. st., 8,000 sq. yds. brick pavt. on conc. base, curb., etc.—Bd. Trustees.

O., Cleveland **noon, June 28**
For grad., drain., curb., pav. and impv. sev. sts.—Comr. Purchases & Supplies.

O., Columbus **noon, June 27**
For grad., drain., curb., pav., etc., on various sts.—W. H. Duffy, Dir. Pub. Serv.

O., Batavia **July 3**
For surf. treat. Cincinnati and Batavia Rd., and for Winchester Rd.—H. C. Reed, Co. Aud.

O., Columbus **1 p.m., June 30**
For grad. rdway., const. bridges and culvts. on Ohio River Rd., and for impv. Dixie Hwy., Lima-Wapakoneta Rd., Sidney-Wapakoneta Rd.—L. C. Herrick, Dir. Hwys. & Pub. Wks.

O., Dayton **June 26**
For pav. no. of sts. and grad. and gravelling—City Engr. Houk.

O., Findlay **10 a.m., July 1**
For const. Deeds Rd. and Collingwood Rd.—Martha Brown, Clk., Co. Comrs.

O., Hamilton **10 a.m., June 27**
For const. two 1-mi. sects. of Center State Line Rd., also oiling Trenton and Jackson Rds.—C. Z. Mikesell, Secr'y, Bd. Co. Comrs.

O., Marion **June 28**
For grad., curb., drain. and const. gutters and catch basins and pav. 8 sts. of city—Chas. Drake, Clk., Bd. Pub. Serv.

O., Sidney **July 3**
For grad. and gravelling Rd. No. 89 in McLane Twp.—W. A. Harmon, Clk., Bd. Comrs.

O., Genoa **noon, June 29**
For pav. West St., incl. grad., sewers, curb. etc.—Earl Camper, Vil. Clk.

O., Bellaire **June 29**
For impv. and const. Flushing Uniontown Rd.—Co. Aud.

Ont., Toronto **noon, July 7**
For conc. pavt., mac. rdway., grad. and mac. base, and conc. abutments and bridge floors—W. A. McLean, Deputy Minister Hwys.

Pa., Edgewood **4 p.m., July 10**
For grad. and pav. 2 alleys—W. H. Garrett, Boro Secr'y.

Pa., Etna **5 p.m., June 26**
For grad., curb. and pav. and const. san. sewer, also repav., recurb., etc.—J. C. Armstrong, Boro Clk.

Pa., Indiana **7 p.m., June 30**
For 28,000 sq. yds. pav., san. sewers, etc.—Thos. Pealer, Boro Engr.

Quebec **June 27**
For 7 mi. oiled W. B. mac. rd. in St. Therese.—J. L. Perron, Deputy Minister, Dept. Rds., Parliament Bldgs.

Tex., Port Arthur **July 12**
For pav. no. of sts.—City Engr. M. C. Erwin.

Tex., San Angelo **10 a.m., June 30**
For impv. St. Hwy. No. 4—J. T. Mathison, Co. Judge.

Tex., Waco **10 a.m., June 28**
For impv. cert. lateral rds. in Rd. Dist. No. 3—W. T. Lockwood, Co. Aud.

Tex., Wichita Falls **10 a.m., June 26**
For grad., culvts. and gravel surf. 7 mi. Iowa Park-Jonesdale Rd.—Co. Aud.

Tex., Richmond **June 26**
For surf. 13.01 mi. St. Hgwy. 36, $156,004.—C. D. Myers, Co. Judge.

Wash., Colfax **July 3**
For surf. 11 mi. st. rd., crushed rock —Co. Comrs.

Wash., Okanogan **July 6**
For grad., drain. and surf. 1 mi. Perm. Hwy.—Bd. Co. Comrs.

Wash., Seattle **10 a.m., June 26**
For const. Orillia-Kent Rd.—Bd. Co. Comrs.

Wash., Olympia **July 5**
For impv. Terrace Place, by clear., grubb., grad. and const. water mains and sewers—City Clk.

Wis., Racine **June 24**
For pav. and resurf. various sts.—Bd. Pub. Wks.

Wis., Madison **10 a.m., June 27**
For grad. and surf. Ashland-Bayfield and Iron River-Brule Rds., and for rd. work on Alma-Mondovi Rd.—Wis. Hwy. Com.

SEWERAGE

Ill., Lake Forest **10 a.m., July 18**
For sewage treatment plants and appurt.—North Shore San. Dist., Lake Co.

Ky., Paducah **10 a.m., June 28**
For const. trunk line sewers and appurt.—Henry A. Pullian, Comr. Pub. Wks. and City Engr.

Mass., Boston **noon, June 28**
For sewerage works in West Roxbury—Jos. A. Rourke, Comr. Pub. Wks.

Mass., Boston **noon, June 29**
For sewerage works in West Roxbury—Jos. A. Rourke, Comr. Pub. Wks.

Minn., Graceville **4 p.m., July 7**
For const. san. sewer system, incl. treatment plant, etc.—J. J. O'Connor, Vil. Clk.

N. J., Bloomfield **8 p.m., July 3**
For storm sewer—Donald F. Peck, Town Clk.

N. J., Morris Plains **June 26**
For reconst. sewage disposal plant at state hospital, $30,000.—B. G. Lewis, Comr., St. House.

N. J., Newark **10:15 a.m., June 26**
For const. sewer.—Thos. L. Raymond, Dir., Dept. Sts. & Pub. Impvs.

N. J., West Orange **8:15 p.m., June 28**
For const. san. and storm sewers—Henry C. Warnick, Town Engr.

N. Y., Richmond **noon, June 29**
For const. temporary san. sewer with appurt.—Matthew J. Cahill, Boro Pres.

N. Y., Thiells **noon, July 13**
For additions to sewage disposal plant at Letchworth Vil.—Mortimer B. Patterson, Pres., Bd. Vil. Mgrs., 7 Wall St., N. Y. C.

N. Y., Mount Morris **10 a.m., June 24**
For const. extension to present outlet sewer.—Bd. Vil. of Mount Morris.

O., Cincinnati **June 26**
For const. 15-in. sewer on Minot Ave.—C. W. Handman, Business Mgr., Bd. Education.

O., Cleveland **noon, June 30**
For liquified chlorine gas for div. sewage disposal—Comr. Purchases & Supplies.

O., Toledo **noon, July 6**
For const. storm water regulators and connections—W. T. Jackson, Dir. Pub. Serv.

O., Perrysburg **noon, June 30**
For const. main outlet sewer in Elm St.—J. W. Lyons, Vil. Clk.

Ont., Elmira **June 24**
For const. 2,100 ft. 8-in. san. sewers —J. H. Ruppel, Town Clk.

Pa., Harrisburg **noon, July 12**
For const. public comfort station—W. H. Lynch, Supt. Sts. & Pub. Impvs.

Va., Roanoke **noon, June 24**
For const. sewer and sidewalks—W. P. Hunter, City Mgr.

Wash., Olympia **July 5**
For impv. alley in Block 74 by sewer —City Clk.

LIGHTING AND POWER

N. J., Jersey City **1 p.m., June 25**
For furn. and installing st. lights, cables and equipment — Boulevard Comrs., Hudson Co.

Wash., Olympia **July 5**
For boulevard ltg. system on Main St.—City Clk.

WATER SUPPLY

Fla., Quincy **3 p.m., July 18**
For water and power plant impvs. and water main ext.—City Council.

Ill., Chadwick **7 p.m., July 7**
For water main ext., incl. c. i. pipe, special castings, 5 hydrants—L. A. Frank, Vil. Clk.

Ind., Hammond **2 p.m., June 26**
For c. i. pipe, valves and valve boxes, etc.—Bd. Pub. Wks.

Ky., Hazard **June 29**
For const. 1,000,000 gal. filter plant, pumping station, reservoir, etc.—A. G. Taylor, City Clk.

Mich., Grand Rapids **2 p.m., July 6**
For const. conc. conduits, filter plant ext.—G. J. Wagner, Dir. Pub. Serv.

Minn., Edgerton **2:30 p.m., June 26**
For erect. flat bottom steel tank on present tower, 25,000 gal. capacity—C. H. Kingsbury, Vil. Clk.

Mo., St. Louis **noon, July 11**
For pumping engine with appurt.—E. R. Kinsey, Pres., Bd. Pub. Serv.

N. J., Bordentown **June 28**
For const. complete water supply system—Hill & Ferguson, 112 E. 19th St. N. Y. C.

N. Y., Manhattan **11 a.m., June 30**
For transferring taps and rearranging connections on water mains, furn. pier lines and dock hydrants, and haul. and lay. water mains and appurt.—Nicholas J. Hayes, Comr. Water Supply, Gas & Elect., Mun. Bldg.

N. Y., Manhattan **10:30 a. m., June 28**
For furn. wet connection sleeves and valves—Bd. Purchase, Grover A. Whalen, Chn., Mun. Bldg.

N. Y., Brighton **10 a.m., June 26**
For furn. and lay. water pipe in cert. sts.—Water Comrs., Powers Bldg., Rochester.

N. Y., Buffalo **11 a.m., June 27**
For piping, with valves, etc., for Col. F. G. Ward Pumping station.—Dept. Pub. Wks.

O., Toledo **10 a.m., July 6**
For filter chemicals, 500 tons iron sulphate—Comr. Purchases & Supplies.

O., Girard **1 p.m., June 24**
For const. steel standpipe, 300,000 gal. capacity—John L. Gleason, Dir. Pub. Serv.

O., Columbus **noon, June 28**
For chemicals for water dept.—W. H. Duffy, Pres., Bd. Purchase.

O., Montpelier **8 p.m., July 10**
For water pipe, valves, etc.—Bd. Pub. Affairs.

Okla., Wewoka **8 p.m., June 26**
For waterworks, inc. 2 sand filters, pump station, etc.—Benahm Engrg. Co., Gumbel Bldg.

Ont., Islington **noon, June 26**
For c. i. pipe, special castings, valves and hydrants, and lay. 8 mi. water mains—Clk.

Ont., Kincardine **2 p.m., June 27**
For slow sand filters and equipment —Waterworks Com.

Pa., Morrisville **8:30 p.m., June 30**
For filtration plant and appurt.—Town Council.

Tenn., Memphis **noon, July 6**
For steam generating and pumping equip.—Bd. Comrs., Memphis Artesian Water Dept.

Wis., Two Rivers **2 p.m., June 30**
For const. 24 in. c. i. intake pipe line, suctions well, etc.—Bd. Pub. Wks.

DRAINAGE AND IRRIGATION

Ark., Eudora **July 1**
For drain. work—Eudora Western D. D.

Ind., Brownstown **2 p.m., July 1**
For const. drain—Ellias B. Douglas, Supt. Construction.

Ia., Pocahontas **1:30 p.m., June 29**
For drain. work in D. D. 114 and 59 —C. W. Gilchrist, Co. Aud.

Minn., Waseca **10 a.m., July 7**
For Jud. Ditch No. 8—Co. Aud.

Neb., Whitney **2 p.m., June 28**
For const. irrigation system—Bd. Directors, Whitney Irrigation Dist.

O., Greenville **June 24**
For impv. Wise Ditch No. 24—Park Townsend, Co. Supvr.

FIRE

O., Cleveland **July 5**
For chemical hose truck, chemical tanks, hose reels, hose, etc.—Jesse L. Sadler, Vil. Clk., Bay Vil.

BRIDGES

Fla., Century **June 27**
For const. rein. conc. deck girder bridge, $30,000.—W. E. Wheat, Engr., Pensacola.

Ind., Versailles **1 p.m., July 3**
For repair of Walter Fitch bridge—W. D. Robinson, Co. Aud.

Ia., Onawa **1:30 a.m., June 26**
For material and const. 20 items of bridge and culvt. work—Co. Aud.

Md., Annapolis **noon, July 6**
For const. hgwy. bridge across South River.—Co. Comrs.

Md., Baltimore **noon, June 27**
For bridge over Severn River.—St. Rds. Com.

Mich., Grand Rapids **1:30 p.m., June 30**
For const. 40-ft. span rein. conc. girder bridge—F. F. Rogers, St. Hwy. Comr.

Minn., Barnesville **9 a.m., June 24**
For const. bridge—C. W. Williams, Town Clk.

Mo., Chillicothe **10 a.m., July 13**
For const. 560 lin. ft. steel bridges—Grand River D. D. of Mo.

N. Y., Manhattan **2 p.m., June 28**
For const. piers for bridge over Beach Channel—Grover A. Whalen, Comr. Plant & Structures, Mun. Bldg.

O., Mt. Gilead **July 14**
For const. superstructure and substructure of Bartlett bridge—M. A. Goff, Clk., Bd. Co. Comrs.

O., Cleveland June 24
For const. bridge work—Frank Lander, Co. Engr.

Pa., Middleburg June 24
For bridge in Snyder Co.—Chas. S. Mattern, Clk., Co. Comrs., Court House.

Pa., Williamsport 10 a.m., July 11
For const. rein. conc. or steel bridge —Co. Comrs.

Quebec June 24
For 9 bridges on Nipissing div., 2 on Ottawa div. and 8 on Montreal div., $250,000.—W. A. Kingsland, Gen. Mgr., Canadian Nat'l. Rys., Band of Toronto Bldg.

S. C., Union June 26
For bldg. bridges on Union-Whitmire Rd.—St. Hwy. Dept., Columbia.

Wash., Olympia 10 a.m., July 14
For const. steel bridge with conc. substructure—Jas. Allen, Supvr. Hwys.

MISCELLANEOUS

D. C., Washington Aug. 2
For 4 Diesel elect. hopper dredges. —Ch. of Engrs., 2902 Munitions Bldg.

Md., Baltimore 4 p.m., July 27
For dredging Wicomico River—U. S. Engr. Office.

Md., Baltimore 10 a.m., June 28
For automobile trucks for water dept.—Bd. Awards.

Mass., Boston noon, June 27
For two 2-ton trucks and scarifying rd. roller—Frank P. Rock, Supt. Supplies.

Mass., Boston noon, June 26
For asph. cem. for const.—Frank P. Rock, Supt. Supplies.

Mont., Butte June 28
For furn. 1,200 gal. combination st. flusher and sprinkler—City Clk.

N. J., Newark 10.15 a.m., June 26
For brick, st. signs, wiping solder, tile pipe—Thos. L. Raymond, Dir. Dept. Sts. & Pub. Impvs.

N. Y., Manhattan noon, June 30
For bldg. ramp and dumping board—John H. Delaney, Comr. Docks, Pier A, North River.

N. Y., Manhattan 10.30 a.m., June 27
For furn. asph. conc.—Bd. Purchase, Grover A. Whalen, Chn., Mun. Bldg.

O., Ashtabula 11 a.m., July 17
For const. rubble mound ext. of West Breakwater—U. S. Engr., Buffalo, N. Y.

Ont., Toronto noon, July 18
For 500 close waste paper and rubbish receptacles—C. A. McGuire, Chn., Bd. of Control.

Ont., Port Burwell June 28
For rebldg. breakwater, $25,000.—R. C. Desrochers, c/o Dept. Pub. Wks.

EXPANSION JOINT

1. Type A-A—Fibre centre non-oozing joint (Solid crown and sides).

2. Type B—Bituminous cellular fibre joint (75% Bitumen).

3. Type D—Cellular fibre joint (solid edges and sides, self expanding).

Type C—Sidewalk joint ½-in. a specialty.

For concrete Roads—Granite, Brick and Wood-block Paving Buildings—Bridges—Walls and Reservoirs.

Samples and Prices on Request.

SERVICISED PRODUCTS CO. 1ST NATL BANK BLDG. CHICAGO

Work Contemplated

STREETS AND ROADS

Alaska—Plan to const. 55 mi. rdway. Eagle River rd. will cost $230,000.

Alta., Mosside — Council decided to purchase four new road graders.

Ala., Troy—Plans being prep. for const. roadways, paving.

Ala., Cook Springs—Meeting held to urge const. Bankhead hgwy. through St. Clair Co.

Ala., Gadsden—City proposes to pav. var. streets.

Ark., Walnut Ridge—Ord. passed pav. and gravel streets.

B. C., Saanich — Council authorized paving of 1,000 ft. of Tyndall Ave. Clerk, H. S. Cowper.

Cal., San Rafeal—Marin co. rejected bids for grad. and surf. Bolinas Co. Rd. Dist. 3.

Cal., Stockton—Plan to impv. streets in Searchlight Addn., 21,667 cu yds. cut, 750 cu. yds. fill, 19,805 lin. ft. conc. curb and gutter, 98,301 sq. ft. conc. walks, 355,072 lin. ft. 2 in. asph. mac. on 4 in. gravel. W. B. Hogan, City Engr.

Cal., Woodland—Yolo co. rejected bids for impv. Prefix 8, Sect. A. A. Proctor, Co. Engr.

Cal., San Bernardino—Bids late in June for conc. curb, cement and conc. culverts, 4 in. oiled mac. pav. and const. conc. wall on 17,750 ft. Hellman Ave. Rd. Dist. 17. H. L. Allison, Co. Clk.

Cal., Fresno—Bids rejected pav. 5 mi. Shaw Ave. C. P. Jensen, Cory Bldg., Co. Surv.

Cal., Amador—Will vote rd bonds in November. Amount not stated.

Fla., Fort Lauderdale — Broward County Commissioners, H. G. Wheeler, chairman, invite bids for widening Las Olos Blvd. from East St. to beach.

Fla., Cocoanut Grove — City voted $60,000 of town hall, sewerage, street improvement and lighting bonds. The Mayor.

Fla., Clearwater—Petition submitted to widen South Fort Harrison Ave.

Fla., Tallahassee—Plans being prep. to pave College av. brk.

Fla., Orlando—Bids about June 20 for const. new rds in Orange.

Hawaii, Honolulu—City and Honolulu co. plans impv. Pail Rd., $150,000, reclaiming 80 acres of reef between Kewalo Basin and Waikiki Canal; also building new concrete and asphalt road to connect boulevards, $500,000. F. Ohrt, City Engr.; I. J. Hopu, City Deputy and Co. Clk.

Ida., Boise — State Hgwy. Bureau plan subway road under Oregon Short Line R. R. tracks, $24,000.

Ill., Pana — Survey completed for const. South Vine St. for pav.

Ind., Decatur—June 19, 1922, at 10 a. m., by treasurer of Adams county, for sale $8,240, $6,000, $6,480, $5,840, $9,680 and $4,720 hgwy. improvement bonds, 4½ per cent., 10 years. James Murphy macadam road in Root and Washington Twps., Simon Sprunger macadam road in Monroe Twp., Pleasant Grove macadam road in Union and Root Twps., Albert Shell macadam road in St. Mary's Twp., Emanuel Sprunger macadam road in Monroe Twp., Ernst Balsiger macadam road in French Twp., as on specifications. Hugh D. Hite, Treas.

Ind., Greensburg—June 29, 1922, at 2 p. m., by treasurer of Decatur county, for sale $22,800 hgwy. improvement bonds, 5 per cent., 10 years. C. A. Whipple et al. in Marion Twp., as on specification. Chas. B. Evans, Treas.

Ind., Princeton—June 21, 1922, at 10 a. m., by treasurer of Gibson county, for sale $4,200 hgwy. improvement bonds, 5 per cent. 10 years. Errett Williams et al. in Montgomery Twp. Stanford Witherspoon, Treas.

Ind., Nashville—July 3, 1922, at 1 p. m., by treasurer of Brown county, for sale, $11,000 and $22,000 hgwy. improvement bonds, 4½ per cent., 10 years. Orville Brummet et al. in Jackson Twp.; H. B. Boling et al. in Jackson Twp. L. J. Snider, Treasr.

Ind., Noblesville—June 24, 1922, at 10 a. m., by treasurer of Hamilton county, for sale $2,400 and $3,200 hgwy. improvement bonds, 4½ per cent., semi-annually. E. A. Pritchard et al., Noblesville Twp. A. G. Finley, Treas.

Ind., Shelbyville—June 24, 1922, at 10 a. m., by treasurer of Shelby county, for sale $6,800 and $9,760 hgwy. improvement bonds, 5 per cent., 10 years. J. B. Monroe et al. in Noble Twp. Jasper Alyea et al. in Moral Twp. Geo. R. Carlisle, Treas.

Ind., Huntington—June 20, 1922, at 10 a. m., by treasurer of Huntington county, for sale, $9,340 and $10,800 hgwy. improvement bonds, 5 per cent., 10 years. Julius Rudig et al. in Polk Twp.; L. J. Rhamey et al. in Dallas Twp. J. Frank Barnes, Treas.

Ind., Petersburg — Plans prep. to const. 35 mi. rock and gravel rds.

Ind., Shoals—June 20, 1922, at 12 m., by treasurer of Martin county, for sale $17,600 hgwy. improvement bonds, 5 per cent., 10 years. S. P. Yenne et al. in Center and Halbert Twps. Theo. McCord, Treas.

Ind., Crawfordsville—June 20, 1922, at 10 a. m., by treasurer of Montgomery county, for sale $3,500 hgwy. improvement bonds, 4½ per cent., 10 years. Geo. W. Hinkle et al. in Walnut Twp. Chas. H. King, Treas.

Ia., Cresco—Bids rejected for coating 32,000 sq. yds. conc. pav. ¾ in. tarvia.

Kan., Ft. Scott—Bourbon co. prep. plan pav. 1mi. F. A. P. 117, 18 ft., bit. mac. B. Boyle, Co. Engr.

Kan., Iola—Plan pav. 17.5 mi. F. A. P. 125, 127 and 128, incl. 9 mi. conc. from here to Fort Scott, 7.5 mi. var. types and 1 mi. conc.

Kan., Oswego—Plans pav. 24 mi. F. A. P. 126, 18 ft., gravel or bit. mac.

Ky., Louisville—Bd. Pub. Wks. orders new walks in var. streets. Bids June 21.

Ky., Frankfort — Tentative agreement made by St. Hgwy. Comn. to const. road between Carrollton and Shelbyville, $146,000.

N. C., Greensboro—Soon call bids for conc. pav., portions of Whitington, Percy, North Spring and Douglass Sts., 5 mi.

Kansas—Bureau of Hgwys., Wash., D. C., approved const. hgwys. for Allen Co. .992 mi. conc. $40,639; Wyandotte Co., 1.073 mi. conc., $87,582.

La., New Orleans—City Comr. urges that petitions for paving be submitted before June 20.

La., Baton Rouge—Final adjustment of Hammond Hgwy. supporters and State Hgwy. Com. may result in completion of New Orleans-Hammond Hgwy. $1,400,000 bond issue proposed.

Maryland — $1,500,000 state road bonds awarded to Alexander Brown & Sons.

Md., Baltimore — Bids July 15 for $300,000 4½ per cent. pub. rd. bonds.

Mass., New Bedford—Bd. of Aldermen consider widening Hillman St. Var. applications made for granolithic walks and driveways.

Mass., Springfield—City Planning Board considering relocation and grading Peconsic Ave.

Mass., Boston—Ware-West Brookfield Hgwy. bill defeated. Commonwealth will contribute $4,000 toward cost of rd. if Hampshire and other towns will contribute.

Mass., Adams—Plan to repair streets, sidewalks and gutters, $40,000.

Me., Portland—City Council considering widening of Free St., $750,000;

Mich., Lansing—Resol. passed to pav. Foster Ave. grad. and gravelled, also Regent St., Illinois Ave., pav. Elm St. and widen Ottawa St.

Mich., Grand Rapids—$1,445,000 to be expended for street and sewer impv.

Mich., Monroe—Will vote June 20 on $100,000 st. impv. bonds.

Minn., St. Paul—City contemp. pav. Raymond Ave., $130,000.

Minn., Madison—Paving — Maturity indef. Consult. Engr., John W. Schaffer & Co., 917 New York Life bldg., Minneapolis, has made survey. Abt. 40,000 sq. yds. M. T. Hoff, Vil. Clk.

Minn., St. Paul—Paving—Preliminary order introduced to city council for paving Western Av. from University to Como av. H. W. Austin, City Purch. Agt.

Minn., Georgetown—Sidewalk—Petn. circulated for 1 mi. walks. A. J. Ostby, City Clk.

Minn., St. Paul—Resol. passed to extend and widen alley in Blk. 16.

Mont., Great Falls—Govt. expected to approve Monarch Logging Rd. W. B. Wiley, Suprvs. of Jefferson Nat. Forest.

Mo., St. Louis—Petition submitted to impv. Utah St. Bids about July 5 for pav. West Park Ave.; Marcus Ave., asph. conc. pavt.; Magaretta Ave., asph. pavt. and conc curb.; Wren Ave., War. bit.; Skinker Rd., Waterman Ave., War. bit.; Clayton Ave., granite curb and Cl. A conc. pavt.

N. B., St. John—It is proposed to extend Millidgeville Ave. to the river.

New Jersey—State Hgwy. Dept. plans impv. 5 mi. Highland Park, Metuchen Rd., $500,000. T. F. Wasser, Broad St. Bank Bldg., Engr.

N. J., Elizabeth—Ord. passed to impv. Second Ave. bit. mac. pavt.; also Third Ave.

N. J., South Orange—Ordinance pass. to widen roadbed at intersection of Prospect st.

N. J., Jersey City—Plans being prep. for widening section between Montgomery st & Van Nostrand av.

N. J., Hoboken—Bond issue for con. rds. in various counties proposed.

N. J., Hoboken—Work in Plankroad will not begin until August.

N. J., Newark—Bids rejected for imp. Swamp rd., Roseland & West Caldwell and approach to Hanover-Cook bridge, Mt. Pleasant av. & resurf. Franklin av.

N. J., Babylon—A $350,000 road bond issue has been submitted to the Town Board for its approval.

N. J., Belleville—Ord. passed auth. $18,000 road bonds.

N. J., Hoboken—Horse Assn. of America has plans to develop and extend bridle paths in cities all over the country.

N. J., Newton—Contracts for rd. work will be let as soon as State Hwy. Com. have approved plans.

N. J., Hoboken—Notice given of proposed impv. of Linden Ave. and State St.

N. Y., Albany—Plan being considered for hgwy. from Albany to Cohoes by conversion at Old Erie and Champlain Canal beds.

N. Y., Syracuse—New York State Railways will expend $250,000 for paving replacements.

N. Y., Mount Morris—Plan to issue $78,000 bonds for const. new brk. pav. in Main and Chapel Sts. has been cancelled because of difference of opinion in narrowing Main St. State Hgwy. Dept. will survey street and new plans will be prepared.

N. Y., Rome—Plans being prep. for const. roadways at Marcy division.

N. Y., Chile Station—Monroe co. plans resurf. 1 mi. Scottville Rd., reconc., $34,000. Co. Engr. Dept., Rochester, Engr.

N. Y., Geneva—Plans road impv. and pav., $110,000.

N. Y., Gouverneur—Plans pav. John St. conc., $35,000. A. M. Jepson, Vil. Clk.

N. Y., Lackawanna—Plans pav. Kirby Ave., $30,000. B. McDonnell, Comr. Pub. Wks.

N. Y., Rensselear—Plans resurf. East St., $25,000-$30,000. L. Greenalch, City Engr.

N. Y., Boro. Bronx—Resol. passed to acquire property from Cedar Ave. to easterly line of New York & Putnam R. R. for widening of and laying out of street.

N. Y., Mt. Morris—Vil. Bd. Trustees plan pav. Main and Chapel Sts., brk., $85,000.

N. Y., Boro. Queens—Plans being prep. for grad., curb., flag. and pav. Lent, Lurting, Merritt Sts. and Lewis Ave.

N. Y., Boro. Bronx—City plans grad., pav., regrad. and sewers in Taylor Ave., Guerlin Pl., Archer St., Theriot Ave., Gun Hill Rd., Norris Ave., E. 135th St., Exterior St., Guion Pl. and Transverse Rd.

N. Y., East Rochester—Plans being considered for pav. East Elm St. and Lincoln Rd.

N. Y., Rochester—City Com. contemp. impv. 21 streets asph. pav.

N. C., Charlotte—Plans to const. 12 mi. Lawyers Rd., asph. on 5 in. conc., $390,000.

N. C., Avery Co.—Rd. Comrs. calling bids for $50,000 road bonds July 3 for Elk and Elk Park Rd. Dists.

N. C., Danbury—Stokes Co. Comrs. passed resolution for issuance of $150,000 bonds for road const.

N. C., Raleigh—Contracts for 55 mi. hgwy. will be let June 28.

O., Towner—Road—McHenry co. Survey being made by T. R. Atkinson, of St. Highway Commission, Bismarck, for F A P from Velva to Ward co. line, on Valley rd. Start wk. soon.

O., Parma Heights—About to vote $6,000 rd bonds.

O., Ashland—Ord. passed auth. $6,000 st. bonds.

O., Middletown—Ord. passed auth. $18,000 M. & C. street bonds.

O., Norwood—Ord. passed auth. S. S. imp. bond issue, $18,400.

O., Delaware—Plans being made for impv. of Center Village Vans Valley and Condit North Rd.

O., Fremont—Prelim. plans prep. for impv. 3 mi. McPherson Hgwy.

O., Warren—Plan to pave Mason St., Garden Ave. and sewering Parkins Wood Blvd., pav. Hillside Dr., S. Chestnut, repav. Hill Ave. and pav. walk on south side at High St., $102,000.

O., Hamilton—Plan to pav. 6 sts. on wes side and const. blvd. lighting sys.

O., Masillon—Plan to repair and repair many sts., incl. drain., curb. brk or blk., bids soon.

O., Lisbon—Plan to impv. Petersberg Rd., conc. on mac.

O., Delaware—Co. Comr. plan to sell $103,450 rd. bonds. June 29.

O., Delaware—Plan to impv. Euclid-Pennsylvania av. rd.

O., Cleveland—Com. Garfield Heights plan repair Broadway.

O., Wapakoneta—Plan pav Willipie and Wood Sts.

O., Akron—Resolution passed to impv. School St. and Lakemont Ave.

O., Toledo—Resolution passed by Twn. Maurice for impv. River Rd., widening to 32 ft.

O., Toledo—$200,000 road bonds sold for impv. county roads.

O., Cleveland—These paving projects are pending: Bellaire, paving outlying streets, for which a bond issue of $80,000 has been approved. C. E. Corlett, Clk., Bellaire. Paving, West Washington St., Cuyahoga Falls; paving Sackett St. and constructing sewer and water lines on Broad. Dayton, paving W. 5th St. to Western Ave., Erie, Pa. Portsmouth, paving 6 mi. of road between here and Ironton, surveys for which are being received.

O., Ironton—Resol. passed to impv. Seventh St.

O., Barberton—Plan to pav. High St., grad. Baird and East Tuscarawas Sts.

O., Ravenna—Plan to pav. S. Diamond and W. Highland Sts. conc. and brk.

Okla., Morris—Bids soon for pav. 12 streets south of Frisco, gravel with asph. top, $126,000. R. Ward, Mayor.

Okla., Stigler—Plans 12,000 sq. yds. pav., $55,000. V. V. Long & Co., Calcord Bldg., Oklahoma City, Engrs.

Ont., Leamington—Preparing plans paving John and Wellington Sts., concrete, $28,000. Prices wanted on all materials. R. M. Selkirk, City Engr.

Ont., Merriton—Plans paving Main St. from Church Corner to Thorold town line, $50,000.

Ont., Sandwich — Hydro-Electric Power Commission of Ontario plans to grade the roadbed between the car tracks on London St.

Ont., St. Thomas—Construction of an asphalt pavement on Wellington St. from Ross to Elgin Sts., is planned. City Engineer, W. C. Miller.

Ont., St. Thomas—Construction work on proposed ravine driveway is to be started from the Hiawatha St. entrance shortly. City Engr., W. C. Miller.

Ont., Toronto—City Council intends to construct a concrete walk on Don Rdway, east side, from Eastern Ave. to Queen St., at a cost of $2,910.

Ontario, Province of—Highway Dept. is calling for tenders for the paving of a 20-ft. strip of roadway on the west side of the radial tracks on Yonge St., Toronto, from the Mausoleum to the southern end of the paved stretch at Newmarket.

Ont., Ailsa Craig—Following tenders were received by Ailsa Craig Farmers' Co-operative Association for construction of concrete grain tanks and warehouse: Jos. Lawson, Credition; E. Barnes, Ailsa Craig; A. K. Stewart, Parkhill.

Ont., Peterboro—Board of Works tabulated a list of proposed repairs and improvements on streets which they sent on to Council for approval. City Engr., R. H. Parsons.

Ont., Toronto—Lowest tenders received by Board of Control for three sections of paving on Lake Shore Rd. total $143,802.

Ont., Toronto—Board of Education has asked the Works Committee to construct sidewalks on Haig Ave., south of Coxwell Ave., in connection with the Earl Haig School.

Ontario, Province of—A provincial highway is to be built from Fort Erie to Port Colborne connecting with the concrete highway to Welland.

Ont., Toronto—Works Committee again recommended the widening of Jane St. in West Toronto to 86 ft. at a cost of $80,000.

Ont., Toronto—Works Commissioner R. C. Harris urged the members of the Civic Works Committee to reach a definite conclusion, at the earliest possible moment, regarding the widening of Yonge St. north of the C. P. R. tracks to Lawton Ave., so that there may be no unnecessary delay in the double-tracking of that thoroughfare as soon as the Transportation Commission is ready to proceed with the work..

Ont., Toronto—If suggestions made by Chief of Police S. J. Dickson to the Ontario Motor League materialize, the roadways of a number of the downtown streets will be widened from one to five feet to accommodate the growing volume of motor traffic. The proposals have been taken up by the executive of the Ontario Motor League and the secretary, W. G. Robertson, has forwarded a letter to the Board of Control recommending their adoption.

Ont., Paris—The estimated expenditures for this year include the following items: Street oiling, $2,000; streets, roads and bridges, $7,000, and concrete walks, $500. Clerk, C. B. Barker.

Pa., Camden—Coun. plans to pav. 15 sts.

Pa., Pittsburgh—Plan being prep. for Mount Washington Rdway. $22,000,000 bond issue being prep.

Pa., DuBois—The 1922 paving program providing for the construction of paving on nine streets has been adopted and bids are to be invited at once on five streets. The city's share will cost $21,000.

Pa., Warren—Street Comm. of Town Coun. are engaged in figuring out a plan whereby sheet asphalt can be spread over the asphalt block on Market St.

Pa., York—The York Co. Comrs. have authorized the issuance of bonds for the loan of $1,000,000 for road construction in the county during the year.

Pa., McKeesport—The City Council sold to the J. H. Holmes Co., of Pittsburgh, $135,000 worth of street impv. bonds that are to draw 4½ per cent. interest. A premium of $3,245 was paid.

Pa., Erie—Ord. passed to grad., curb, drain. and pav. Twenty-third St.

Pa., Erie—Plans, grad., pav. and curb. Plum St., brk or blk., cement sidewalks on 29th, 20th, French, Raspberry, 25th and Cranberry Sts., $25,000.

Pa., Kittanning—Plans pav. 4 mi. Kaylor Rd. from Allegheny River to Kaylor, $200,000.

Pa., Sharon—Bids about July 5, new pavts. on 4 streets, resurf. 5 streets, reconst. East State St., brk. and asph.; also trunk san. sewers in Clark Ave. and Union St. and sewers in var. sts., $55,000.

Pa., North Catasnqua—Will resubmit $35,000 st. bond issue.

Pa., Northhampton—$2,000,000 rd. imp. and bridge const. bonds voted.

Que., St. Lambert—Work is to be started soon on a bitullithic surface for Front St. and the River Road as far as the limits of St. Lambert, while the 1,700 ft. of unimproved surface in Montreal South is also to be reconstructed.

Que., Montreal—Soon takes bids for cement sidewalks on Clark St. from Kelly to Boiseau Sts., $9,112; Clark St. from Kelly to Dick Sts., $5,765; Lasalle Ave., Dandurand, Delormier, Mentana and Charlemagne Sts., totaling $10,390. E. Blanchard, Road Supt.

R. I., Coventry—Coun. plans to permanently repair Lincoln Ave.

Saskatchewan, Province of—Highways Department will build road leading into Piapot.

S. C., Aiken—City plans hard surfacing one mile of Park Ave.; concrete, brick or asphalt. The Mayor.

S. D., Sioux Falls—Resol. passed to grad. Fourteenth St. Petit. submitted to grade Eighth St.

South Dakota—Bureau of Hgwys., Wash., D. C., approved proposed const. rds. in Miner Co., 5.5 mi. G. & D. const., $19,492; Lincoln Co., 7 mi. G. & D. const., $18,177; Brown Co., 6 mi. gravel, $127,-555.

Tex., Dallas—New pavement for ten sts. provided for in st. impvt. budget.

Tex., Dallas—Contracts will be awarded June 30 for const. 13.43 mi. mac. and gravel base rd.

Tex., Coleman—Plans submitted to State Hwy. Dept. for const. hwy., gravel and conc., $90,000.

Tex., Waco—Plan submitted for const. hwy. and rd. in McLennan Co., bit. mac. re-conc., $320,050. J. P. Lester.

Tex., Georgetown—Plan const. rd. in Williamson Co., $100,000, gravel surf. and conc.

Tex., Coleman—Plans being prep. for const. rd., gravel surf. and conc., $132,-400. W. E. Dickerson.

Tex., Lufkin—Plans being prep. for Hwy. No. 35 in Angelina Co., grav. surf. and conc., $75,000. John F. Robinson.

Tex., San Angelo—Plans being prep. for const. Hwy. No. 9-A, $65,000. Gibb Gilchrist, Engr.

Tex., Waco—Plans being prep. surf. and rock grav. and bit. topping hwy., $110,000.

Tex., Clarksville—Plans being prep. grad. and gravel surf. 3.5 mi. St. Hgwy. 5, $25,000. Gravel furn. by county. J. B. Rieman, Clarksville, Engr.

Tex., Georgetown—Bids about July 27, pav. 7 mi. var. sts., bids on conc., gravel and rock base; also several types asph. top, $200,000. W. N. Harris, Engr.

Tex., Seguin—Guadalupe co. plans grading and gravel surf. 3.4 mi. State Hgwy. 3, between here and San Antonio, 13,194 cu. yds. borrow, 10,538 cu. yds. roadway, 660 cu. yds. concrete, 9,160 cu. yds. gravel surfacing, 86,240 lbs. reinforcing, 3,700 lbs. Hess & Skinner, Southwestern Life Bldg., Dallas, Engrs.

Tex., Richmond—Fort Bend co. voted $500,000 bonds for hgwy. improvements in Rd. Dist. 1. Nagle-Witt-Rollins Eng. Co., Wharton, Co. Engr.

Tex., Young Co.—$300,000 rd. bond issue proposed.

Tex., Corsicana—Will soon vote on a street bond issue, amount of which is not stated.

Tex., Canyon—Voted in favor of issuing paving bonds. (Amount not stated.)

Tex., Jefferson Co. (P. O. Beaumont) Road District No. 1—Attorney General Austin approved $2,000,000 5% sr. road bonds.

Tex., Falls Co. (P. O. Maclin)—Recently voted $100,000 5½% road bonds. E. M. Dodson is Co. Judge.

Utah, Sevier Co. (P. O. Richfield)—An issue of hgwy. bonds $240,000 has been voted.

Va., Franklin Co. (P. O. Rockymount)—An issue of road bonds $50,000 has been proposed.

Va., Newport News—Plan to vote $300,000 paving bonds.

Va., New Canton—Plans completed for const. of tri-country hgwy. hard surf., curb and gutter.

Va., Princess-Anne—Princess Anne co. plans 4 mi. concrete road from Kempsville to Salem Church. J. C. Wood, Chn. Bd. Supervs.

Va., Portsmouth—Norfolk co. plans to issue $110,000 bonds for concrete road in Great Bridge Dist. R. B. Preston, New Kirn Bldg., Co. Engr.

Va., Petersburg—Pembroke Land Corp. will develop residential section at outskirts of here, incl. streets, walks and sewers, $50,000. B. C. Syms, Pres. Engr. not selected.

Va., Norfolk—Appropriated $25,000-$30,000 to pave portions of Manteo and Fanquier Sts.; also drain part of 34th St. Work will probably be done by day labor. C. E. Ashburner, City Mgr.

Wash., Hillyard—Petn. submitted for pav. impvt. in two avs.

W. Va., Charleston—Bids about July 11 for impvt. rds. in 13 counties. Grad drain pav. & tar cold surf. application.

W. Va., Moundsville—Rejected bids opened May 22 paving Jefferson and Morton Aves. Will readvertise. Noted May 18.

Wis., La Crosse—Paving—Will take bids soon. Approx. 8 mi. Alt. bids on brk., asph., concr. and asph. macadam. A. Birnbaum, City Clk.

SEWERAGE AND SANITATION

B. C., Saanich—By-law providing for an ultimate issue of $750,000, of which $270,000 will be raised immediately to inaugurate sewerage system in the municipality, will shortly be submitted to the ratepayers.

Cal., Williams—Election soon to vote on bonds for constructing sewerage system. C. F. Sloan, Santa Fe Bldg., San Francisco, Consult. Engr.

Cal., Stockton—Plans prep. const. North St. San. Proj., 210 lin. ft. 4 in. and 1,694 lin. ft. 6 in. pipe, etc.; Fair Oaks N. San. Proj., 12,730 lin. ft. 4 in. and 15,900 lin. ft. 6 in. pipe, etc.

Cal., San Pablo—Plans prep. for Chelsea Ave. Lat. Sewer 2, 23,408 lin. ft. 6 in. vitr. pipe; Market St. Lat. Sewer 1, 28,740 lin. ft. 6 in. and 2,300 lin. ft. 8 in. vitr. pipe; Church St. Lat. Sewer 3, 8,008 lin. ft. 6 in. and 655 lin. ft. 8 in. vitr. pipe; Belmont Ave. Lat. Sewer 4, 3,364 lin. ft. 6 in. vitr. pipe. R. Calfee, 221 South 22nd St., Richmond, Engr.

Cal., San Luis Obispo—Voted $20,000 bonds for sewer impv.; $15,000 bonds for septic tank; $8,500 bonds for culverts; $15,000 bonds for bridges. W. B. Burch, Lowe Bldg., Engr.

Cal., Merced—Election soon to vote 60,000 bonds impv. and enlarging sewers, $60,000.

Col., Alhambra—$300,000 sewer bonds voted.

Fla., Deland—Election will be held soon to vote on $90,000 bond issue for construction of sewers. J. B. McCrary Co., 3rd Natl. Bank Bldg., Atlanta, Ga., Engrs.

Ill., Monmouth—Plans being prep. for two sewers.

Ill., Chicago—Plans prep. for Lake View relief sewer for city Bd. Local Impv., $2,000,000. C. D. Hill, Engr.

Ia., Council Bluffs—Sewer—Resolution adopted to const. san. sewer on S 8th st., bet. 16th & 24th avs. 1,334'6", 1,050' 8", 1,190' 10" 800' 12" vit. pipe, 6 m. hs. O. Hochman, City Clk.

Ia., Blairstown—Prep. plans and opening bids about Aug. 1 for 3 mi. 6-12 in. san. sewers, $32,000. M. Tschirgi & Son, 711 Amer. Trust Bldg., Cedar Rapids, Engrs.

Md., Baltimore—Bids being called for sewage disposal plant in Crownsville.

Md., Hagerstown—Plan to extend city sewerage sys., $117,930.

Mich., Menominee—Will soon take bids for 24 and 30 in. vitr. sewers in Jenkins St., Elizabeth, Wells and Somerville Aves., $25,000.

Mich., Detroit—Had plans prepared 4,937 ft. sewer in Trombly Ave. from St. Aubin to Elliott Aves. 4 ft. to 6 ft. 3 in. diam.; 3,353 ft. Harper Ave. Arm, Sect. 1 of Ashland Ave. Sewer, in Harper Ave. from Alter Rd. to point 1,967 ft. north of Harper Ave., 4 ft. 3 in. to 8 ft. 6 in. diam.; 2,813 ft. Harper Ave. Ext. of Ashland Ave. Sewer, in Harper and Nelson Aves. from Newport to Wade Aves., 3 ft. 3 in. to 4 ft. 3 in. diam.; 2,569 ft. Carrie Ave. Arm of North Six Mile Rd. Sewer, in Carrie Ave. from Six Mile Rd. to Nevada Ave., 3-5 ft. diam.; 2,905 Moran Ave. Arm of McDougall Ave. Sewer, in Leland Ave. from McDougall to Moran Aves., and Moran Ave. from Leland to Garfield Aves. 20-45 in. diam., brick, monolithic concrete or vitr. segment block. J. W. Reid, City Engr.

Mich., Adrian—The City Commission has voted to construct six sewers this summer and also to build seven stretches of curb and gutter, also in 1922.

Minn., Graceville—Sewer Sys. Disposal Plant—Ready for bid soon. Consult. Engr., C. J. Buell, 205 Davidson bldg., Sioux City, Ia. 10,000' 15" and 4,500' 8" sewer. A. W. Bruers, City Clk. $30,000.

Minn., Harmony—Sewers—Engr., Louis P. Wolff, 1000 Guardian Life bldg., St. Paul, making plans for complete sanitary sewer sys. T. Sanderson, Jr., City Clk.

Minn., Chaska—Sewers—Consult Engr., John W. Schaffer & Co., 917 New York Life bldg., Minneapolis, making plans. J. B. Connolly, Vil. Clk

Minn., Rochester—All bids rejected for const. storm sewer.

Minn., Columbia Heights (P. O. Minneapolis)—Sewers—Maturity indef. Consult Engr., John W. Schaffer & Co., 917 New York Life bldg., Minneapolis, has made survey.

Mo., Cameron—City Council retained Benham Engineering Co., Kansas City, Mo., as consulting engrs. for impvs. to sewage disposal plant.

Mo., Kansas City—An election to vote an issue of sewage disposal bonds to the amount of $4,000,000 is being contemplated.

Neb., Grand Island—Storm, San. Sewer Sys., Sewage Disp. Plant—Voted to issue $300,000 bonds. Henry E. Clifford, City Clk. W. E. Buell & Co., 205-7 Davidson bldg., Sioux City, Ia., Engr.

Neb., Emerson—San. Sewers—Ready for bids abt. July 1. Consult. Engr., W. E. Buell & Co., 205 Davidson bldg., Sioux City, Ia. 26,000'. Care City Clk. $47,000.

N. B., St. John—A new system of sewerage for the Shamrock grounds is being considered. R. W. Wigmore, Commissioner of Water and Sewerage.

N. J., Haddon Heights—Bids rejected for ext. sewerage system.

N. J., Irvington—Bids being called for const. storm sewer.

N. J., Boro Garwood—Ord. passed to const. 15 in. vit. pipe drain, catch basins, manholes, etc., in Third Ave., also lateral sewer in New St. and Willow Ave.

N. Y., Elmira—City will sell $200,-000 bonds for impv. and building new sewers. G. W. Jarchow, Clk.

N. Y., Canandaigua—Will offer soon $120,000 sewer disp. bonds.

N. C., Madison—Bd. Aldermen to sell $30,000 bonds on June 20, to construct sewerage system. J. C. Thompson, City Clk.

N. D., Carrington — Sewage Disposal Plant—Engr., Louis P. Wolff, 1,000 Guardian Life bldg., St. Paul, has made plans. Maturity indef. C. C. Carnaham, City Clk.

O., Maple Heights—It is proposed to const. sewerage system (segment block and some brick) and sewage treatment station, $300,000. C. W. Courtney, Leader-New Bldg., San Francisco, Consult. Engr.

O., Cleveland—Plans being prep. for sewage impv. in Cuyahoga county, $70,000. R. F. MacDowell, Engr.

O., Cincinnati—Bids being called for const. sewer.

O., Columbus—Bd. Comrs., Franklin co., plans sanitary sewer in territory east of Parsons Ave. from Kian Ave. to Marion Rd. and in Marion to Lockbourne Rds., 15, 18 and 24 in. at var. places, $27,700.

Ont., Toronto—City Council intends to construct sewers in Dewson St. at a cost of $3,880.

Ont., St. Thomas—Work on the construction of the sanitary sewer under the eastern end of Malakoff St. will be started shortly, work to be done by day labor. No. 2 Committee of City Council also recommended installation of sanitary sewer under Hiawatha St. by day labor. City Engr., W. C. Miller.

Pa., Erie—Plans 8, 9 and 12 in. tile sanitary service in Elmwood Ave., 28th, 29th, 30th and Cherry Sts., total $27,-100. F. G. Lynch, City Engr.

Pa., Verona—Bids about June 26 for const. storm sewer.

Pa., Johnstown—$700,000 san. sewer bonds being offered.

Que., Montreal—It is planned to const. brick sewer in several streets, $64,780. F. V. Dowd, Ass't. Supt., Sewer Dept.

S. D., Redfield—Sewer—Contemp. storm and san. sewers and sewage disposal plant. C. J. Mariner, City Aud.

Tex., Jackson—$70,000 sewer bonds voted.

Tex., Dallas—Will soon offer $100,000 sewer bonds.

Tex., Jacksboro—City will const. sewer system; voted $70,000 bonds.

W. Va., Clarksburg—City will const. storm and sanitary sewer on W. Main St.

Wis., South Milwaukee—Bids being called for const. sewers.

Wis., Whitefish Bay—City contemp. const. sewers, water mains and pav., $60,000.

Wis., Watertown—Bd. Pub. Wks. contemp. san. sewer.

Wis., Hurley—Sewer Improv.—Contemp. J. A. Emunson, City Clk. $19,-500.

Wis., Weathy—Sewer Sys.—Plans in prog. O. L. Leum, City Clk. W. G. Kirchoffer, Madison, Engr.

Wis., Fond du Lac—San. Sewer — Contemp. on Griffith st. bet. Morris st. & river. A. M. Hunter, City Clk.

LIGHTING AND POWER

Ala., New Brockton—City will vote on issuance of $8,500 of bonds for improving electric light system. The Mayor.

Fla., Jacksonville—Application filed to obtain power from Ochlocknee River by West Florida Power Co.

Fla., Cocoanut Grove—City voted electric light bonds. The Mayor.

Fla., Jacksonville—Schofield Engineering Co., Philadelphia, Pa., is consulting engr. for improvements to municipal electric plant; to install 10,000 K. W. generator, doubling capacity; estimated expenditure, $280,000. City Comrs.

Fla., Homestead—An election will be held on July 5 to vote an issue of electric, water, paving and fire department bonds, $115,000.

Ia., Missouri Valley—An election will be held on June 19 to vote an issue of electric light plant bonds, $80,000.

Md., Baltimore—Plan to develop huge hydro-electric plant on Susquhanna between tidewater and plant at Haltwood.

Mich., North Muskegon—An election will be held to submit to the voters the question of issuing electric extension bonds, $30,000.

Pa., York Haven—York Haven Water & Power Co. plan to expend $1,000,000 for impv. of plant.

Pa., Harrisburg—City auth. 22 more street lights in city.

Wis., Muscodo—$15,000 electric light bonds voted.

WATER SUPPLY

Ala., Anburndale—City voted $30,000 bonds for const. of water works.

Ark., Russelville—City contemplates erecting water and light plant. The Mayor.

Ark., Lepanto—The following bonds have been authorized: $34,00 water, $32,000 electric light, $28,000 sewer.

Cal., Hermosa Beach—Election soon to be held on $500,000 bond issue for following improvements: Buying present privately-owned water works systems; sewerage system; auditorium on pier; extending present pier 300 ft. into ocean; purchasing fire fighting apparatus.

Fla., Winter Garden—Town voted $33,000 bond issue for const. water works. R. B. Haddon, Mayor.

Fla., Deland—Plans have been prep. for const. water works. Election soon to vote on $116,000 bonds. J. B. McCrary Co., 3rd Natl. Bank Bldg., Atlanta, Ga., Engrs.

Ill., Joy—Plans being prep. for waterworks sys., $35,000. Coldwell Engr. Co., Jacksonville, Ill., Engr.

Ill., Shelbyville—Ord. passed approp. $5,300 for water purposes.

Ia., Oskaloosa — Plans being completed for water wks., $300,000. Burns & McDonnell, 402 Interstate Bldg., Kansas City, Mo., Engrs.

Ia., Oskaloosa—Voted $230,000 bonds to purchase water works, $70,000 to improve same and $370,000 for hydro-electric development on Des Moines River. Burns & McDonnell, Interstate Bldg., Kansas City, Mo., Engrs. Noted Oct. 6 and Dec. 22.

Ia., Storm Lake—Waterwks Improvs. —Voted to issue $40,000 bonds. Roy W. Kinne, City Clk.

Ia., Belle Plaine—A recent election resulted in favor of issuing $50,000 water works extension bonds.

Kan, Phillipsburg—Plans 6½ mi. 8 in. mains, purification plant, pumping plant, etc., $100,000. Black & Veach, Mutual Bldg., Kansas City Mo., Engrs.

La., Alexandria—$360,000 bond issue voted for water reservoir mains, fire dept. and gas plant.

Md., Williamsport—$100,000 municipal bonds voted for water sys.

Me., Auburn—City will soon take bids for main extension from Lake Auburn pumping station, 12,000 ton c. i. pipe. A. W. P. Cobb, Clk., Water Comn.

Mich., Redford—City will lay 65,810 ft. of 4-24 inch cast iron water mains and construct pump house, etc. Detroit Water Bd., Detroit, Engrs.

Mich., Lansing—Will soon offer $10,000 water and sewer bonds.

Mich., Iron Mountain—Water Sys.— Work to start soon. Michigan Iron, Land & Lmbr. Co. Filtration plant on Woodward Ave.

Minn., Storden—Waterwks—Plans in prog. Consult. Engr., W. E. Buell & Co., 205 Davidson Bldg., Sioux City, Ia. City Clk., P. B. Fields.

Minn., Edgerton—Water Sys.—Voted to erect water tank, extend water mains, sink well, erect pump house. C. H. Kingsbury, City Clk.

Minn., Stephen—Waterwks Sys.—Maturity indef. Will vote on bond issue. Engr., Louis P. Wolff, 1000 Guardian Life Bldg., St. Paul, has made survey. O. G. Gunderson, Vil. Clk.

Minn., Winsted—Waterwks Sys.—Maturity indef. Consult. Engr., John W. Schaffer & Co., 917 New York Life Bldg., Minneapolis, has made survey. About $50,000. Fred Roof, Clk.

Minn., Fridlay—City Coun. contemp. waterworks sys., $2,000,000. Maturity indef.

Minn., Minneapolis — City Coun. contemp. waterworks ext. about Aug.

Minn., Springfield—Water works extensions are planned, $22,000. Druar & Milinowski, 500 Globe Bldg., St. Paul, Engrs.

Minn., Edgerton—Plans are being made for water works impvs., incl. new steel tank, 25,000-30,000 gal. capacity, on old tower, and city is considering extending mains, sinking new well, purchasing new pump and building new pumphouse. Engr. not selected.

Mo., Ketesville—Vote will probably be taken in near future on bond issue for installing water works.

Neb., Phillips—Waterwks Sys.—Contemp. 35,000 gal. tank on 100 ft. steel tower. E. C. Huxtable, City Clk.

Neb., Lincoln—Plans laying mains in Dist. 30, 51st St. from South to Sumner Sts., 52nd St. from South to Sumner Sts., 53rd St. from South to Franklyn Sts., 58th St. from South to Franklyn Sts., Franklyn St. from 53rd to 58th Sts.; Dist. 31, Pawnee St. from 14th to 17th Sts., 1,965 ft. 6 in. and 4,470 ft. 4 in. c. i. pipe. G. W. Bates, City Engr.

Neb., Hay Springs—An election will be held on June 20 to vote an issue of water works bonds to the amount of $18,000.

N. J., Trenton—Sealed proposals will be received until June 16 for furnishing and erection of one Ames Unaflow engine, one Root rotary pump, one electric generator, one condenser and one atmospheric check valve. Leon D. Hirsch, City Clk.

N. Y., Kennedy—Village plans the following impvs.: (1) extensions to water mains and general impv. of water system, $18,000; (2) const. of new sewers in 5 streets, $12,368.75. Engr. not announced.

N. Y., Caledonia—Town of Wheatland will take action June 19 on petition from Munford for establishment of water dist., $24,333.

N. Y., Riverton—City will soon take bids on 200,000 gal. steel tank and tower; also 4-8 in. mains. W. P. Webber, City Engr.

N. Y., Greece (Ridge Road Fire Dist. (P. O. North Greece)—A recent election resulted in favor of issuing fire truck bonds to the amount of $10,000.

N. C., Madison—City will const. water and sewer systems; voted $100,000 bonds.

N. C., Kernersville—City voted $58,000 bonds for const. of water works system. Carolina Eng. Co., Wilmington, Engrs.

N. C., Madison—Bd. Aldermen to sell $70,000 bonds, on June 20, to construct waterworks system. J. C. Thompson, City Clk.

N. C., Kernersville—$105,000 water and s ewer bonds voted.

O., Cleveland — Plans being prep. impv. water mains. R. F. McDowell, Engr.

O., Salem—City will soon take bids on rein.-con. reservoir, tank house, pipe lines, etc. Morris Knowles, Jones Law Bldg., Pittsburgh, Pa., Engr.

O., Rome—Franklin co. (Columbus) plans laying 1½ mi. 6 in. pipe, pump and standpipe; also drilling 8 in. well, 175 ft. deep, here. E. T. Bradbury, Gugle Bldg., Columbus, Engr.

Okla., Granite—Voted $20,000 bonds constructing waterworks. V. V. Long & Co., Colcord Bldg., Oklahoma City, Engrs.

Ont., Thornbury — City is having plans prepared for new water works system, $30,000. Prices are desired on pumps, pipe, etc. James, Proctor & Redfern, 36 Toronto St., Toronto, Engrs.

Ont., Woodbridge—Plant for water works system are being prepared, $25,000. James, Proctor & Redfern, 36 Toronto St., Toronto, Engrs.

Ont., New Toronto — Reeve Gardhouse will propose the submission of a by-law for debentures for a waterworks system from New Toronto to serve Long Branch and the Lake Shore Road district as far west as Etobicoke Creek, south of the Grand Trunk Railway tracks.

Ont., Riverside — Carlottie Bros., Walkerville, secured contract for construction of cast iron water main on Clair View, Elinor and John M. Sts., and also from Eau Claire water plant to Little River.

Ont., Sarnia—With the approval of the City Council, the waterworks committee accepted tenders for annual supplies, as follows: Gartshore-Thomson Pipe & Foundry Co., Hamilton, 4 and 6-in. cast iron pipe at $57 per ton; Kerr Engine Co., 4-in. valves, $9.55, 6-in. valves, $16.33; Mueller Mfg. Co., valve boxes, $7.46; pig lead, $6.25 per hundred pounds; Dominion Steel Products Co., fire hydrants, $66 each.

Ont., York Twp.—Township Council authorized an expenditure of $11,982.30 for 6-in. water mains. Engr., Frank Barber, Toronto.

Ont., Islington — A water supply scheme to take in the area from the west of New Toronto east to Long Branch Park, and south from the railway to the lake, at an estimated cost of $98,000, was submitted to the Etobicoke Township Council by James, Proctor and Redfern, Ltd., Consult. Engrs., Toronto.

Ore., Toledo—$22,500 water ext. bonds voted.

Pa., Lawrenceville — Plans waterworks system. Cost between $25,000 and $30,000. Address H. C. Cloos, Lawrenceville, Secy.

Pa., Philadelphia—City will soon call for bids on installing ash and coal handling equipment at Queens Lane pumping plant, about $25,000. Bids will also be called for on furnishing and installing pumping units at Larners Point pumping station, $35,000, and for quantity of patent sleeves, stop valves and water pipe, $12,000. C. E. Davis, City Hall, Chief of Water Dept.

Que., Montreal—Plans 25,000,000 gal. reservoir, 500 ft. square and 18 ft. deep, Atwater Ave., $500,000. H. A. Tetreault, Dir. Pub. Wks.

R. I., Central Falls—It is proposed to impv. and extend water pipe system, $150,000. S. P. Cummings, City Engr.

Tex., Floresville — $10,000 water works bonds voted.

Tex., Munray—$60,000 water ext. bonds voted.

Wash., Monroe—City will call for bids in near future on water works system, incl. 1,000,000-gal. concrete reservoir, 6 mi. 8-18 in. and 32,500 ft. 4-10 in. wood stave pipe, 425 cu. yds. concrete, 14,000 cu. yds. excav., $84,000. Miller Eng. Co., Burke Bldg., Seattle, Engrs.

Wash., Walla Walla—It is proposed to const. Division 2 of water system, incl. four mi. pipe line to Wenaha Nalt. Forest, gravity type dam, 100 ft. wide, 16 ft. high, sluice gates, telephone pole line and wagon road, $140,000. E. B. Hussey, Alaska Bldg., Seattle, Engr.

W. Va., Wheeling—The J. N. Chester Engineers, Pittsburgh, Pa., are now prep. plans and specifications for new water works system for city, $2,000,000.

Wis., South Milwaukee—Bids being called for waterwks.

Wis., Sparta — City Coun. contemp. ext. water service.

Wis., Eagle River—Water Sys.—Contemp. Ed. Eckhoff, Supt. Water and Light Dept. W. G. Kirchoffer, Madison, Engr.

Wis., Blue Mounds—Waterwks Sys., Reservoir—Contemp. Peter Brage, Vil. Clk. $7,000.

FIRE

B. C., Victoria—The Victoria fire department has been authorized to purchase a fire truck or a motor pump at a cost of $4,000. The wreck of one of the department's trucks last year has impaired the efficiency of the department and new equipment is required at once according to the chief.

Cal., Dinuba—Voted in favor of $15,000 5½% fire engine bonds. C. T. Reagan, City Clk.

Del., Milford—The Carlisle Fire Co. is taking steps to secure necessary financial backing for the erection of a new fire house and the purchase of another hook and ladder truck.

Fla., Homestead—It has been decided to impv. the fire dept.

Md., Denton—There is a movement to buy apparatus for a volunteer fire company here. The town has a small volunteer department with little or no equipment.

Mass., Leicester—Each of the three districts in this town wants a piece of motor apparatus.

Mass., Turners Falls—The horse-drawn chemical is to be motorized at cost of $2,500.

Mass., Ludlow—A special town meeting was conducted and it was voted ao appropriate $885 for better fire protection.

Mont., Miles City—Chief Aitchison announces that the department is in need of equipment, including a deluge set for mounting on the apparatus, 1,-000 ft. of hose, two shut off nozzles and one life net.

Mont., Missoula—The City Council has authorized the fire chief, James T. Cranney, to advertise for bids for 1,-500 ft. 2½-in. hose, a gas mask and a cellar nozzle.

Mont., Baker—Mayor Heinrich appointed L. M. Corbitt the marshal to install hydrant and hose at the pump house for fire facilities.

N. J., Asbury Park—City is in need of new fire apparatus.

N. Y., Riverhead—The fire commissioners will ask the taxpayers at annual meeting in July for an appropriation of $10,000 for motor apparatus.

N. Y., Greece—Residents of the Ridge Road fire district voted unanimously to pay $10,000 for fire truck, with triple combination equipment.

N. Y., Le Roy—Citizens are considering the question of purchasing new fire apparatus.

N. Y., Wayland—It is planned to purchase site for new firemen's building which, it is expected, will be erected during the coming summer.

N. Y., Woodbury—City has voted to buy two motor fire trucks.

N. Y., Mechanicville—At a special election taxpayers voted $14,000 for fire apparatus. The vote was 221, and against 40.

N. Y., Ellicottville—Village seeks appropriation for fire truck, $1,900.

O., Newton Falls—Ordinance has been passed authorizing mayor to purchase five hundred feet of fire hose.

O., Mansfield—Ordinance has been passed to provide for purchase of apparatus and supplies for fire dept.

O., Olive Branch—A fire here has entailed a loss of $50,000. Further destruction was prevented by the arrival of the Cincinnati department. Cincinnati was not summoned only as a last resort as the charge for their services is $100 per hour. The village is without any adequate equipment.

O., Kenton—The electric fire alarm signal system of this city has been damaged and rendered inoperative as the result of the big storm which visited the city last week.

O., Delaware—The council of the Village of Ashley has purchased a Prospect motor fire truck, combination pump chemical hose and ladder for the department of that village.

O., Warren—City Solicitor Marion Lea will draw a new lighting contract with the Ohio Public Service Co. calling for a rate of $19.50 a year for 100 candle power lights. The present contract is for the same price for 60 candle power. It remains to be seen whether the company will accept.

O., St. Clairsville—Volunteer fire dept. is being organized.

O., Mt. Vernon—Ordinance has been passed to issue bonds for purchase of buying hose and hydrants for fire dept.

O., Ironton—The village of Wheelersburg has just been visited by a $25,000 fire. The village having no fire protection, aid was furnished by the department of the village of New Boston.

O., Akron—Ord. passed auth. $6,500 6% 1-9 yr. sr. Fire Department bonds.

O., Mt. Vernon—Auth. $44,000 5% street bonds and $1,000 6% 1-5 yr. sr. Fire Department bonds.

O., Oberlin—Ord. passed auth. issue of 5½% semi-annual, coupon Engine and Pump bonds, $15,000.

Pa., New Bethlehem—Repairs to fire truck have been recommended.

Pa., Erie—Safety Director Eichorn has recommended a bond issue of $20,-000 for a new fire alarm system here.

Pa., Bainbridge—In near future a meeting will be held to decide kind of apparatus to be purchased for fire protection in this section.

Pa., Steelton—Citizens' Fire Engine House is being remodeled.

Pa., Glenside—Two thousand dollars of the $13,000 needed to purchase new fire truck were collected recently.

Pa., McKees Rocks—Bond issue has been passed for impv. fire protection.

Pa. Corry—It is reported that the fire dept. of this city will be motorized.

Pa., Old York Road—The sum of $40,000 will be expended by three volunteer fire companies for apparatus.

Pa., Nanty Glo—Fire Co. No. 1 will raise funds for new equipment.

Pa., Appolo—Fire dept. is in need of more up-to-date equipment.

R. I., Woonsocket—National Underwriters' Association suggests the erection of new fire station to replace present No. 3 station.

Tex., Houston—This city, O. F. Holcombe mayor, will close bids this week for the construction of a fire and police station. The structure will be of steel and will cost $175,000.

W. Va., Mannington—The West Virginian Fire Underwriters' Asso. has recommended that better fire protection be provided for this town.

BRIDGES

Ala., Huntsville—State Hgwy. Dept., Montgomery, Ala., plans building of concrete bridges on Big Cove Rd. from Huntsville to Marshall county line.

Ark., Texarkana—Will vote June 24 on bond issue for const. 3 bridges across Sulphur River, $65,000.

B. C., Victoria—Pub. Wks. Committee has been authorized to rebuild a 40-ft. bridge on Shelbourne St. City Engr., F. M. Preston.

Conn., New Haven—Expect Govt. approv. for temporary Tomlison bridge in few days, $43,000.

Fla., Daytona—Volusia Co. Comrs., DeLand, Fla., plan to reconst. present concrete brdge at estimated cost of $135,000.

Fla., Fort Lauderdale—Co. Comrs., H. G. Wheeler, chairman, will erect two concrete bridges to replace present wooden bridges over canal at Himmarshee Park. Commrs. plan to place concrete supports around wood piling of bridge across Las Olas sound.

Fla., Quay—St. Lucie co. (Ft. Pierce) voted $35,000 bonds const. 5,000 ft. timber trestle and sand fill, over Indian River. R. D. Carter, Vero, Engr.

Ga., Savannah—Plans for const. of bridge across Savannah River have been completed and will be sent to district federal road-bridge engr. at Montgomery, Ala., for approval. State Hgwy. Dept., Atlanta, will invite bids in a few days. First part of bridge will be across Front River and will be 1,490 ft., incl. draw span; concrete. Middle part of bridge will be 1,815 ft. long, and of concrete. Other section of bridge will be 1,990 ft. long (across Little Back River), and of either concrete or treated timber. Two smaller bridges will be built across Laurel Hill and Beach Hill Canals; concrete or treated timber. Division Engr., State Hgwy. Dept., Savannah. W. R. Neel, State Hgwy. Engr., Atlanta.

Mo., Howard Co—$105,000 bridge bonds voted.

Neb., Geneva—Fillmore co. plans bridge P 541, between Sects. 9-16 Bryant Twp., one 16 ft. conc. slab, conc. abutments, 20 ft. rdway.; bridge H 221, between Sect. 26-35, Belle Prairie Twp., one 20 ft. conc. arch, 16 ft. rdway., conc. abutments, alternate of 20 ft. I beam slab, 16 ft. rdway. on steel pile abutments; bridge N 241, between Sects. 28-33, Bennett Twp., one 20 ft. arch, 16 ft. rdway., conc. abutments, alternate of 20 ft. I beam, 16 ft. rdway., steel pile abutments; bridge M B 31, between Sects. 23-24, Grafton Twp., one 16 ft. conc. slab, 16 ft. rdway., conc. abutments, alternate 17 ft. I beam, 16 ft. rd. steel pile abutments.

N. J., Pompton Lake—Boro Com. requested Passaic Co. Bd. Freeholders to widen Ringwood Ave. bridge.

N. J., Jersey City—Headings will be held to consider elimination of grade crossings.

N. Y., Boro Queens—Plans being made to const. subway under Queens Boulevard.

N. Y., Pulaski—Twn. Richland considering replacing lift bridge across Salmon River, $18,000. Will call meeting soon for bond issue to constr. new bridge, $52,000.

North Carolina—Bids rejected const. re-conc. bridges and culverts on State Proj. 888, Yancey co. Will readvertise. $40,000.

N. C., Lenoir—Plans prep. for new conc. bridge over Johns River.

O., Toledo—Request made to eliminate East Bdwy. grade crossing. Will consider $150,000 proposed bond issue. Subway under tracks about $450,000.

O., Steubenville—Senate auth. const. bridge across Ohio River.

O., Paintsville—Under a contract just awarded work is to be begun immediately on a steel bridge across the Big Sandy River at the mouth of Paint Creek. A companion bridge will be erected over Buffalo Creek and a new road will tap the highway to Inez, Martin Co.

Ont., Sioux Lookout—On June 14, by-law providing for the raising of $10,000 for const. of bridge, grading, etc., will be submitted to ratepayers. Clerk, J. E. Cole.

Ont., Birch Cliff—General contr. for four-roomed addition to Birch Cliff Public School, S. S. No. 15, was awarded to Norman McLeod, Ltd., at approximately $37,500. Burden, Gouinlock & Carter, Toronto, Associate Architects.

Ont., Toronto—The proposal for a subway under the G. T. R. track at Ashdale Ave. was again presented to the Works Committee after being laid over for a year.

Pa., Phila.—Details for const. Delaware River bridge being discussed.

Pa., York—Co. Comrs. decided to replace large wooden bridge across Codarus Creek on state hgwy. between Spring and Hanover.

Pa., Dunnsville—Steel work is being rushed for the construction of a new bridge over the Normanskill creek on the Western turnpike road to replace the old wood covered bridge which has served for 80 years.

Pa., Saltsberg—Old wooden bridge spanning Kiskiminetas River has been destroyed by fire.

S. C.—New bridges are to be constructed over the Pacolet River on the Chesnee Road and on the National Highway and an inter-county bridge over the Enoree River between Spartanburg and Laurens.

S. C., Union—State Hgwy. Dept., Columbia, invites bids until June 26 for erecting bridge over Tiger River on Union-Whitmire Rd., Union county; 13 22-ft. concrete spans and 168-ft. steel span; 107,985 lbs. steel reinforcement; 163,000 lbs. structural steel. Bids are invited until the same date for constructing reinforced concrete bridge over Union-Whitmire Rd., four 22-ft. spans. W. B. Deneen, Co. Engr., Union.

S. C., Charleston—South Carolina State Hgwy. Dept., Columbia and Charleston San. Draining Comn. having plans prep. for bridge over Ashley River, $500,000.

S. C., Barnwell—Hgwy. Dept. has plans to const. bridge over Salkehatchie River. Bids late in June.

Tex., San Antonio—Southern Pacific R. R. bridge and international bridge spanning Rio Grande have been washed away by flood.

Tex., Ballinger—Runnels co. plans 300 ft. bridge over Elm Creek, on State Hgwy. 7, with one 125 ft. steel truss span on conc. piers and conc. trestle

Tex., Runnels Co. (P. O. Ballinger)—A petition is being circulated for an election to vote the issuance of the following bonds: Colorado River bridge, $50,000; Elm Creek bridge, $35,-000; Elm Creek bridge, $30,000.

Tex., Canadian—Bids being called for new bridge over Washita River, two 80-ft. steel spans, five bents 19½ ft. long as trestle approaches, $12,500.

Wash., Seattle—Plan const. huge steel bridge across Snake River on route of Inland Empire Hgwy. Constructing steel bridge with concrete abutments and approaches over the Snake river at Central Ferry. Federal aid project No. 98, involving the following approximate quantities: 3000 cu. yds. of excavation for substructure. 4270 cu. yds. concrete. 210,000 lbs. reinforcing steel. 1,900,000 lbs. structural steel; grading and draining of 0.75 mile of the Pacific highway, Chehalis southeast, in Lewis county; clearing, grading and draining 1 mile of the Pacific highway south of Castle Rock in Cowlitz county. Plans and specifications covering the above work will be on file at the office of the Journal of Commerce within the next few days, according to word received from Olympia today.

Wash., Everett—Petn. being signed for const. new bridge across Snohomish River.

W. Va., Charleston—Plans being prep. to urge const. Watts St. viaduct.

W. Va., Benwood—Joint meeting held to decide constr. new bridge at Hickman's mine between two towns.

TOO LATE FOR CLASSIFICATION

STREETS AND ROADS

Cal., Sacramento 2 p.m., July 3
For const. 10.8 mi. st. hwy. in Santa Barbara Co. and 8.8 mi. in Orange Co. —A. B. Fletcher, St. Hwy. Engr.

Ill., Chicago 11 a.m., June 27
For const. pav. on various sts.—Bd. Local Impvs.

Minn., Buffalo 2 p.m., July 10
For excav. and overhaul—E. R. Anderson, Co. Aud.

N. J., Atlantic City July 12
For rd. pav. in Atlantic Co.—Bd. Freeholders, Guarantee Trust Bldg.

N. J., Elizabeth 2.30 p.m., July 5
For impv. cert. sts. by pav., curbs and gutters—Jacob L. Bauer, Co. Engr.

N. Y., Albany 1 p.m., July 11
For impv. 4.15 mi. hwy. in Cattaraugus Co., 8.82 in Chenango, 7.59 and 7.70 in Delaware, 1.60 in Madison, 10.14 in St. Lawrence, 0.62 in Washington, 4.68 in Wyoming and 2.92 in Yates, and for reconst. 1.27 mi. in Chenango Co.—Herbert S. Sisson, St. Hwy. Comr.

Okla., Oklahoma City June 27
For 2 mi. gravel rd., Proj. 55, Muskogee Co.—St. Hwy. Com.

Ore., Salem 10 a.m., June 28
For grad. and rock surf. 4 rds. in Clackamas, Curry, Umatilla and Union Cos., and const. bridges in Douglas, Lincoln and Sherman-Gilliam Cos.—St. Hwy. Com.

Ore., Salem 10 a.m., June 29
For grad. and rock surf. rds. in Douglas, Tillamook, Umatilla and Wallowa Cos., and const. bridges in Baker, Union and Wasco Cos.—St. Hwy. Com.

Tex., Dallas 9.30 a.m., June 27
For 1,400 lin. ft. combination curb and gutter—E. Beulah Cauley, Secr'y of Boards.

Vt., Montpelier June 27
For 5.71 mi. gravel rd. in Orange, 2.15 in Concord and 1.97 gravel or bitum. mac. in Lunenburg—St. Hwy. Com.

Wis., West Allis June 26
For pav.—Bd. Pub. Wks.

SEWERAGE

Ind., South Bend June 27
For const. sewer—Bd. Pub. Wks.

Ind., East Chicago 2 p.m., June 26
For const. sewer in Fir st.—Bd. Pub. Wks.

Me., Lisbon 2 p.m., June 26
For const. portion of system of sewers and drains with appurt.—Town Bd.

Minn., Barnum July 7
For sewer, water sys.—City Clk. A. D. Lathe.

S. D., Sioux Falls 9 a.m., June 26
For work in Sewer Dist. 18, also for sewer serv. connections—W. C. Leyse, City Clk.

Wash., Edmonds 8 p.m., June 27
For lateral sewer systems—Geo. M. Leyda, City Clk.

Wis., South Milwaukee June 27
For sewers—City Council.

WATER SUPPLY

Cal., Los Angeles 2 p.m., June 27
For shut off valves, steel pipe and rivets—Dept. Pub. Serv.

D. C., Washington noon, July 17
For const. portion of water supply conduit for D. C.—U. S. Engr. Office, Old Land Bldg.

Minn., St. Paul 11.30 a.m., July 3
For furn. 12 filter operating tables for water dept.—H. W. Austin, Purch. Agt.

O., Hamilton June 27
For disc water meters with couplings—W. F. Mason, Serv. Dir.

Okla., Fairland June 30
For const. waterworks, incl. well, pump house, tank, tower and for 10 mi. transmission line—L. C. Overmiller, Pres., Bd. Trustees.

S. D., Sioux Falls 9 a.m., June 26
For water serv. connections from mains—Walter C. Leyse, City Aud.

Tex., Dallas 10 a.m., June 26
For generator, meter box lids and rings—M. G. James, City Secr'y.

Wash., Walla Walla June 27
For ext. 20-in. pipe line in Wenaha forest—Engr. E. B. Hussey.

BRIDGES

Minn., Argyle 2 p.m., June 27
For bridge over Middle River—H. S. Beckwith, Town Clk.

O., Columbus 10 a.m., July 8
For const. cert. bridges — Bd. Co. Comrs.

Pa., Sunbury June 26
For reconst. bridge in Northumberland Co.—Co. Comrs.

Tex., Hempstead July 2
For const. iron span 150 ft. long and 16 ft. wide—Comrs., Court of Waller Co.

W. Va., Charleston 10 a.m., July 11
For repair of bridge, const. sects. of State rd., also for clean., tar cold surf., etc.—St. Rd. Com.

MISCELLANEOUS

D. C., Washington 2 p.m., July 11
For removing old piles and portion of pier, dredging, etc.—Comrs, D. C.

La., New Orleans noon, June 29
For furn, creosoted piles—Bd. Comrs., Port of N. O.

N. Jersey City 3 p.m., June 27
For repair, pier and dredging—Bd. City Comrs.

N. Y., New York July 12
For dredging in Passaic River, N. J. —War Dept., 39 Whitehall St.

Pa., Philadelphia July 16
For dredging in Del. River, Camden, N. J.—War Dept., Dist. Engr.

R. I., Providence July 12
For rock removal in Stanford Harbor, Conn.—War Dept., Asst. Engr.

STREETS AND ROADS

Ala., Morgan Co.—(P. O. Decatur).—County Board of Revenue plans issuing $409,000 Road bonds.

Ark., Eudora—The City Council will place on the market Paving bonds to the amount of $20,000.

Cal., San Mateo—$124,000 Street Imp. bond issue awarded.

Fla., St. Johns Co.—(P. O. St. Augustine).—An election will be called to vote a Road bond issue. (Amount not stated).

Fla., Jacksonville—Citizens request half mile hard surf. hgwy. be added to 104th St. road.

Ida., Sand Point—$10,000 Road bond issue voted.

Ida., Montpelier—$55,000 Road bonds voted.

Ind., Spencer Co.—$3,000 Road bonds for Grass Twp. roads awarded to State Bank of Chrisney.

Ind., Greene Co.—$8,000 Richland Twp. Road bonds awarded to Meyer-Kiser Bank.

Ind., St. Joseph—$74,000 Road bonds awarded to Fletcher Savings Bank.

Ind., Pike Co.—$12,788 Road bonds awarded to City Trust Co., Indianapolis.

Kan., Crawford Co.—$500,000 Road bonds awarded.

Ky., Grant Co.—$250,000 Road and Bridge bonds awarded to Weil, Roth & Co., Provident Savings Bank & Trust Co.

La., Plaquemines Par.—$235,500 Road Dist. bonds awarded to Prudden & Co., Toledo.

Mich., Marshall—$12,000 bond issue for paving East and West St. will soon be offered.

Mich., Muskegon Heights—The city council took final action June 5 on $65,000 General Improvement and $25,-000 Street Work bonds.

Mich., Newaygo—Will vote June 19 on $15,000 Paving bonds.

Minn., Detroit — $150,000 Paving bonds awarded to Wells-Dickey Co., Minneapolis.

Minn., Otter Tail Co.—$82,000 Hgwy. reimbursement bonds awarded to Drake Ballard Co., Minneapolis.

Minn., Mankato — $60,000 Paving bonds awarded to Drake Ballard Co., Minneapolis.

Miss., Panola—$50,000 Hgwy. Dist. bonds awarded to A. K. Ligrett & Co., Memphis.

Neb., North Platte—$50,000 Paving bonds voted.

N. J., Jersey City—Bids being called for const. Hudson Co. blvd.

N. J., Hoboken—Ord. passed auth. $300,000 Street bonds and $10,000 Temporary Impv. bonds.

N. Y., Westfield—Voted $46,000 Paving bonds.

N. Y., Youngstown—(Official report). —J. L. Hall, village clerk, informs us that no bond issue has been considered and that an election to vote on $18,000 Paving bonds was reported erroneously.

N. Y., Albion—$30,000 Street Paving bonds voted.

N. Y., Nassau Co.—$1,500,000 Road Impv. bonds awarded to B. J. Van Ingen & Co., New York.

N. Y., Clyde—Will offer $36,000 Hgwy. bonds in near future.

N. Y., Oriskany—$3,000 Madison Street Impv. bonds voted.

N. Y., Mt. Morris—Will vote during latter part of June $78,000 Street bonds. $18,000 Street bonds.

N. Y., Schenectady—Plan to impv. Erie blvd. and development of Washington Ave., $600,000 to $800,000. Ord. prep. for grad., pav. and laying sidewalks, widening and impv. Washington Ave.

N. C., Mount Holly—$20,000 Street bonds awarded the Central Bank & Trust Co.

O., Fremont—Ord. passed auth. $30,-000 Street bonds.

O., Marietta—Ord. passed auth. $18,-000 Street bonds.

O., Middletown—Ord. passed auth.

O., Sidney—Will vote June 27 on Street subway bonds, $120,000.

O., Hicksville—Ord. passed auth. $7,-500 M. & S. Street bonds.

Okla., Rogers Co.—(P. O. Claremore). —County commissioners are considering a Road bond issue. (Amount not stated).

Okla., Beckman Co.—(P. O. Sayre).—An election will be held in the near future to vote an issue of Road bonds., $500,000.

Pa., East Pittsburgh—Council has passed an ordinance providing for a $38,500 bond issue for Street improvements.

Pa., Economy Twp.—On May 16 an issue of $45,000 Road bonds was favorably voted.

Pa., Red Lion—A petition has been received by the Council to issue Paving bonds. (Amount not stated).

Pa., Lansdale—The election held May 16 to vote on $60,000 Street bonds was carried.

Pa., Indiana—Council is preparing to issue $50,000 Street Improvement bonds.

Tex., Yonng Co.—$300,000 Road bond issue has been proposed.

Tex., Hearne—City considers issuing $200,000 Road bonds.

Tex., Georgetown—City voted $85,-000 Paving bonds.

Tex., Fort Bend—$500,000 Road bonds voted.

Va., Franklin Co.—$50,000 Road bonds being contemplated.

Va., Newport News—$600,000 School and $300,000 Paving bonds will be voted during this month.

SEWERAGE AND SANITATION

Fla., Miami Beach—Will vote July 25 on $125,000 Sewer bonds.

Fla., Cocoanut Grove—$60,000 Sewerage, Streets and Light bonds voted.

Fla., Winter Haven—$255,000 Sewer System, Paving, City Hall and Electric Light bonds awarded to Sidney Spitzer & Co., Toledo.

Mich., Detroit—Bids rejected for $8,-000,000 Public Sewer bonds.

Minn., Grand Rapids—$20,000 Sewer Construction bonds awarded to Kalman Wood & Co., Minneapolis.

Minn., Eveleth—$60,000 Sewer Ext. and $15,000 Water Works bonds voted.

Minn., Springfield—$22,000 Water Works bonds voted.

Mo., Kansas City—The City contemplates an election to vote on $4,000,000 Sewerage Disposal bonds.

N. J., Phillipsburg—$250,000 Sewer bonds awarded.

N. J., Collingswood—$250,000 Sewerage bonds will be offered.

O., Dover—$11,500 Storm Sewer bonds awarded to State Industrial Com.

O., Akron—An issue of Sewage Elimination bonds, $700,000, is awaiting the approval of the city council.

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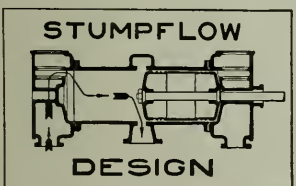

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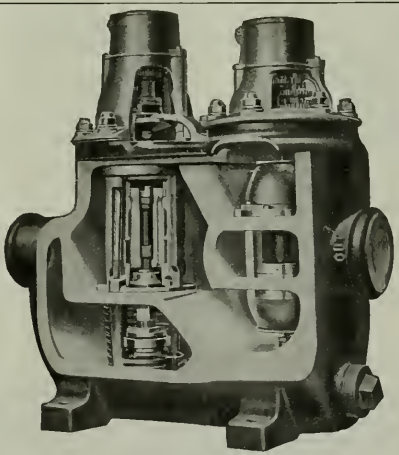

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OFFICIAL ADVERTISING

PENNSYLVANIA STATE HIGHWAY DEPARTMENT, HARRISBURG, PA.—Sealed proposals will be received at the State Capitol until 10 a. m., June 28, 1922, when bids will be publicly opened and scheduled and contract awarded as soon thereafter as possible for the reconstruction of 25,122 ft. of One Course Reinforced Concrete Pavement in Bradford County, Route No. 20; 21,044 feet of One Course Reinforced Concrete and Hillside Vitrified Brick Pavement in Cambria Country, Route No. 54; 9,638 feet of One Course Reinforced Concrete Pavement in Clarion County, Route No. 214; 7,118 feet of One Course Reinforced Concrete Pavement in Clearfield County, Route No. 234; 8,710 feet of either Bituminous Surface Course on a Concrete Foundation or One Course Reinforced Concrete Pavement in Erie County, Appl. Nos. 1880 and 1875, and 12,997 feet of either Bituminous Surface Course on a Concrete Foundation or One Course Reinforced Concrete Pavement in Erie County, Route No. 258; 39,082 feet of One Course Reinforced Concrete Pavement in Indiana County, Route No. 228, and 27,632 feet of One Course Reinforced Concrete Pavement in Indiana County, Route No. 228; 24,856 feet of One Course Reinforced Concrete Pavement in Lackawanna County, Route No. 365; 27,081 feet of One Course Reinforced Concrete Pavement in Lawrence County, Route No. 79; 22,171 feet of One Course Reinforced Concrete Pavement in Susquehanna County, Route No. 12; One Span Plate Girder Bridge in Cumberland County, Route No. 250; 803 feet of One Course Reinforced Concrete Pavement in Westmoreland County, Application No. 1264. Bidding blanks and specifications may be obtained free, and plans upon payment of $2.50 per set, upon application to State Highway Department, Harrisburg. No refund for plans returned. They also can be seen at office of State Highway Department, Harrisburg, 1001 Chestnut Street, Philadelphia, 119 Federal Street, N. S., Pittsburgh, Pa. George H. Biles, Assistant State Highway Commissioner. (23-24-25)

PENNSYLVANIA STATE HIGHWAY DEPARTMENT, HARRISBURG, PA.—Sealed proposals will be received at the State Capitol until 10 a. m., June 27, 1922, when bids will be publicly opened and scheduled and contract awarded as soon thereafter as possible for the reconstruction of 6,067 feet of One Course Reinforced Concrete and Hillside Vitrified Brick Pavement in Armstrong County, Route No. 251; 11,215 feet of One Course Reinforced Concrete Pavement in Bradford County, Route No. 20; 13,917 feet of One Course Reinforced Concrete and Hillside Vitrified Brick Pavement in Butler County, Route No. 251; 9,596 feet of One Course Reinforced Concrete Pavement in Cambria County, Route No. 62, and 23,751 feet of Either Vitrified Brick or One Course Reinforced Concrete and Hillside Vitrified Brick Pavement in Cambria County, Route No. 221; 2,510 feet of One Course Reinforced Concrete Pavement in Clarion County, Route No. 27, and 12,815 feet of One Course Reinforced Concrete and Hillside Vitrified Brick Pavement in Clarion County, Route No. 214; 7,057 feet of One Course Reinforced Concrete Pavement in Crawford County, Application Nos. 1867 and 1868; 28,323 feet of One Course Reinforced Concrete Pavement in Indiana County, Route No. 262; 18,709 feet of One Course Reinforced Concrete Pavement in Jefferson County, Route No. 338; 8,648 feet of One Course Reinforced Concrete Pavement in Lackawanna County, Route No. 322; 12,048 feet of One Course Reinforced Concrete Pavement in Luzerne County, Route No. 4; 24,042 feet of One Course Reinforced Concrete Pavement in McKean County, Route Nos. 100 and 101; 15,659 feet of One Course Reinforced Concrete Pavement in Northumberland and Montour Counties, Route No. 2; 20,057 feet of One Course Reinforced Concrete Pavement in Susquehanna County, Route No. 174; and One Reinforced Concrete Bridge in Cumberland and York Counties, Route No. 123. Bidding blanks and specifications may be obtained free, and plans upon payment of $2.50 per set, upon application to State Highway Department, Harrisburg. No refund for plans returned. They also can be seen at office of State Highway Department, Harrisburg, 1001 Chestnut Street, Philadelphia, 119 Federal Street, N. S., Pittsburgh, Pa. George H. Biles, Assistant State Highway Commissioner. (23-24-25)

PROPOSALS FOR
PUBLIC COMFORT STATION

June 21st, 1922.

Sealed proposals will be received by the Superintendent of Streets and Public Improvements, Harrisburg, Pa., at his office, Room No. 408, Dauphin Building, Harrisburg, Pa., up until noon of Wednesday, July 12th, 1922 (Standard Time), for the construction of a Public Comfort Station, N. E. Corner, Second and Market Streets, Harrisburg, Pa.

(1) General Contract.
(2) Plumbing.
(3) Heating and Ventilating.
(4) Electric Lighting and Power

Plans and specifications may be seen at the office of the Superintendent of Streets and Public Improvements or at the office of C. Howard Lloyd, Architect, Suite A, Telegraph Building, Harrisburg, Pa. Bidders may obtain drawings and specifications by depositing with either of the above the sum of $25.00 which will be refunded upon the return to the office from which they were received, not later than noon of July 12th, 1922, of all plans and specifications in good order.

Proposals will be received and considered only upon the terms and conditions set forth in the specifications and are to be properly marked and addressed to the undersigned.

The right to reject any or all bids is reserved.

W. H. LYNCH, Superintendent.

(25)

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WATER WORKS IMPROVEMENTS
Reading, Pennsylvania

SEALED PROPOSALS will be received by the Council of the City of Reading, Pennsylvania, until 8:30 A. M., Eastern Standard time, Wednesday, July 5, 1922, for the following contracts:

Contract No. 24—Foundations and Suction Vault for Pump No. 4.

Contract No. 25—Cast-Iron Pipe and Specials.

Contract No. 26—Test Borings.

Plans, specifications and bidding blanks can be had after June 21, 1922, at the office of the Chief Engineer, Bureau of Water, Reading, Pa., upon deposit of ten dollars, which deposit will be returned to the successful bidders and to others upon return of plans and specifications in good condition not later than 30 days after the opening of the bids.

Bidders must accompany their bids by cash, proposal bond or certified check for an amount equal to 10 per cent. of the total amount of the bid.

A satisfactory bond will be required for the faithful performance of the contract, for an amount equal to one-half of the total amount bid.

In all the work herein embraced, preference shall, at all times, be given to local laborers and mechanics and the contractor must comply with the Workmen's Compensation Insurance Act.

Proposals must be made separately for each contract, enclosed in separate envelopes with contract number marked thereon, and addressed or delivered to City Council, in care of City Clerk, City Hall, Reading, Pa.

Council reserves the right to reject any or all bids and to accept any bid which, in its judgment, is for the best interests of the city.

D. E. DAMPMAN,
Supt., Dept. of Parks and Public Property.

EMIL L. NUEBLING,
Chief Engineer, Bureau of Water. (25)

HIGHWAY WORK
OFFICE OF THE STATE COMMISSION OF HIGHWAYS

Sealed proposals will be received by the undersigned at their office, No. 55 Lancaster Street, Albany, N. Y., at one o'clock P. M., advanced standard time, which is twelve o'clock noon eastern standard time, on Friday, the 30th day of JUNE, 1922, for the improvement of highways in the following Counties:

ALLEGANY .....(one highway):2.77)
CHAUTAUQUA .....(one highway:4.59)
FRANKLIN .....(one highway:2.23)
LIVINGSTON .....(one highway:6.65)
ONONDAGA .....(one highway:7.16)
ST. LAWRENCE .....(one highway:9.38)
SCHUYLER .....(one highway:4.99)
SUFFOLK .....(one highway:8.33)
WESTCHESTER .....(one highway:0.93)

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of the division engineers in whose division the roads are to be improved. The addresses of the division engineers and the counties in which they are in charge will be furnished upon request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON,
Commissioner.

J. C. FINCH,
Secretary. (24-25)

TENDERS FOR RUBBISH RECEPTACLES

Sealed tenders addressed to the Chairman of the Board of Control will be received by **registered post only** up to 12 o'clock noon on Tuesday, July 18th, 1922, for the supply of five hundred (500) **Closed Waste Paper and Ruhbish Receptacles** carrying advertising matter, to be placed at determined and designated locations on the streets of Toronto. Tenders must be plainly marked on the outside of envelope "Tenders for Waste Paper and Ruhbish Receptacles." Form of tender and conditions of tendering and specifications may be had on application at the office of the Street Commissioner, Room No. 1, City Hall. The usual conditions pertaining to tendering, as prescribed by city by-law, must be strictly complied with. The highest or any tender not necessarily accepted.

C. A. MAGUIRE (Mayor), Chairman. (25)

HIGHWAY WORK
OFFICE OF STATE COMMISSION OF HIGHWAYS

Sealed proposals will be received by the undersigned at their office, No. 55 Lancaster Street, Albany, N. Y., on Tuesday, the 11th day of July, 1922, at one o'clock p. m., advanced standard time, which is twelve o'clock noon, eastern standard time, for the improvement of highways in the following counties:

CATTARAUGUS .....(one highway: 4.15)
CHENANGO .....(one highway: 8.82)
DELAWARE .....(two highways: 7.59 & 7.70)
MADISON .....(one highway: 1.60)
ST. LAWRENCE .....(one highway: 10.14)
WASHINGTON .....(one highway: 0.62)
WYOMING .....(one highway: 4.68)
YATES .....(one highway: 2.92)

ALSO FOR THE RECONSTRUCTION OF THE FOLLOWING:

CHENANGO .....(one contract: 1.27)

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of the division engineers in whose division the roads are to be improved or reconstructed. The addresses of the division engineers and the counties in which they are in charge will be furnished upon request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON, Commissioner.
J. C. FINCH, Secretary. (25-1-2)

O., Portsmouth—Dr. O. D. Tatje, health commissioner, will appeal to the council to establish a garbage disposal plant. He will do this on the instruction of the city health board.

Pa., Heidelberg—On May 16 voted in favor of $55,000 Sewer bonds.

S. C., Greenville—$300,000 Sewer bonds and $100,000 Water bonds voted.

Tex., Jacksboro—Bids until June 29 for $70,000 bonds for const. sewer sys.

W. Va., Morgantown—Ord. passed auth. $750,000 Sewer bonds.

W. Va., Morgantown—An election will probably be held July 13 to vote on $750,000 Sewer bonds.

Wis., Two Rivers—$100,000 Sewer bonds voted.

LIGHTING AND POWER

Fla., St. Petersburg—$350,000 Electric Light bonds voted.

Ga., Meigs—$15,000 Electric Light bonds recently voted will be offered soon.

Ia., Missouri Valley—About to vote $90,000 Municipal Electric Light and Power Plant bonds.

Mich., North Muskegon—Will submit $30,000 Electric Extension bond issue soon.

Minn., Wilmont—Voted $14,000 Electric Light Plant bonds.

Neb., Herman—About to vote $11,500 Electric Light bonds.

N. D., Hillsboro—$12,000 voted for electric distribution system.

N. C., Hobgood—Will issue $10,000 Electric bonds. E. L. Bradley is clerk.

Okla., Okenah—A resolution has been introduced calling for the issuance of $75,000 to $100,000 Electric Lighting Extension bonds.

Okla., Locust Grove—Voted $20,000 Light bonds.

WATER SUPPLY

Cal., Hermosa Beach—An election has been called to vote $500,000 bonds for the following purposes: Municipal water works system, municipal sewer system, municipal auditorium, pier extension, fire fighting apparatus, piping in city.

Fla., West Palm Beach—$100,000 High Pressure Water, $10,000 Waterfront Impv. bonds voted.

Ia., Columbus—About to vote $10,000 Municipal Water Works bonds.

La., Winnsboro—$500,000 Water and Sewerage bonds voted.

Md., Williamsport—On June 6 voted $100,000 Water System bonds.

Mass., Brockton — $60,000 Water bonds awarded to Old Colony Trust Co., Boston.

Mich., Lansing—Will soon offer for sale $10,000 Water and Sewer bonds.

Mich., Buchanan—An election will be held in the near future to vote an issue of Water bonds. (Amount not stated).

Mo., Eldon—$81,000 Water Works and sewer bonds voted.

Neb., Columbus—Election July 11 for const. water works system and main storm sewer extension, $35,000.

Neb., Thurston—$13,800 Water bonds awarded to White Phillips Co., Denver.

N. J., Burlington—Ord. passed auth. $20,000 Water bonds and $10,000 Paving bonds.

O., Oberlin—Ord. passed auth. $15,000 Engine and Pump bonds.

Okla., Hugo—Will issue $150,000 5½ per cent Water bonds.

Ore., Drain—$18,000 Water bonds awarded to Rice & Rice.

Pa., Brnddock—Will vote July 17 on $14,000 Water System bonds.

S. C., Greenville—$300,000 Sewer and $100,000 Water bonds voted.

Tex., Jacksboro—Bids June 29 for extension water system, $5,000.

Tex., Floresville—The Attorney General has approved $10,000 5 per cent 10-20 year op. Waterworks bonds.

Va., Bristol—An election will be held on August 3 to vote an issue of Water Works bonds to the amount of $50,000.

W. Va., Williamsport—Voted $10,000 Water bonds.

BRIDGES

Ill., Chicago—The voters of the city have approved the issuance of the following bonds: Bridge, $3,400,000; Lighting, $2,000,000.

Mo., Saline Co.—(P. O. Marshall).—The election held on June 2 resulted by a vote of 5,778 to 1,700 in favor of issuing Bridge bonds to the amount of $300,000.

N. Y., Lily Dale—On May 9 voted in favor of issuing $12,000 Bridge bonds.

N. Y., Schenectady—The Schenectady Trust Co. was the successful bidder for the 6 months Bridge notes to the amount of $385,000 at 3.75 per cent plus a premium of $3.75. Wm. A. Wick, City Comptroller.

O., Sidney—An ordinance was passed by the City Council on May 22, authorizing an issue of 6 per cent Bridge Construction bonds, $5,500.

Tex., Fort Bend Co.—(P. O. Richmond).—An election will be held on July 1 to vote an issue of State Highway and Bridge bonds, $100,000.

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Sullivan Mchy. Co.

Air Compressors, Portable
Ingersoll-Rand Co.

Ash Handling Mach.
Blaw-Knox Co.

Angle Splice Bars
Sweet's Steel Co.

Asphalt Block Press
Nat'l Moulding Press Corp.

Backfillers
Pawling & Harnischfeger Co.

Bar Benders
Ransome Concrete Mach. Co.

Bar Cutters
Ransome Concrete Mach. Co.

Bins
Ransome Concrete Mach. Co.

Blasting Powder
Atlas Powder
Du Pont de Nemours Co.

Bolts, Tee Head
Sweet's Steel Co.

Braces, Trench
The Duff Mfg. Co.

Bridges
American Bridge Co.
Blaw-Knox Co.
Russell Grader Mfg. Co.
Truscon Steel Co.

Bridge & Wharf Timbers (Creosoted)
Wyckoff Pipe & Creo. Co., Inc.

Buckets, Automatic & Dumping
Blaw-Knox Co.
Ransome Concrete Mach. Co.

Buckets, Clam Shell

Dragline, Orange Peel
Blaw-Knox Co.
L. P. Green
Russell Grader Mfg. Co.

Cableways
Flory Mfg. Co.

Cars, Dumping and Industrial
Good Rds. Mchy. Co., Inc.
Koppel Industrial Car & Equipment Co.

Carts, Concrete
Acme Road Mchy. Co.
Columbia Wagon & Body Co.
Ransome Concrete Mach. Co.

Castings
Burch Plow Works Co.
Republic Iron Works
South Bend Foundry Co.
U. S. Cast Iron Pipe & Foundry Co.

Caterpillar Tractors
Holt Mfg. Co., Inc.

Chutes, Concrete
Ransome Concrete Mach. Co.
U. S. Cast Iron Pipe & Foundry Co.

Clips, Rail, Forged
Sweet's Steel Co.

Concrete Block Machines
Republic Iron Works

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Ball Engine Co.
Erie Steam Shovel Co.
Koehring Co.
Orton & Steinbrenner
Pawling & Harnischfeger Co.

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Pawling & Harnischfeger Co.

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Wyckoff Pipe & Creo. Co., Inc.

Cross-Ties (Creosoted)
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Good Rds. Mchy. Co., Inc.

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Sullivan Mchy. Co.

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Heil Co., The
Mandt Body Co.

Dump Wagons
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Austin-West. Rd. Mach. Co.
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Heil Co., The
Standard Steel Wks.
Tiffin Wagon Co.

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Avery Co.
Flory Mfg. Co.
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Ball Engine Co.
Blaw-Knox Co.
Erie Steam Shovel Co.
L. P. Green
Koehring Co.
Osgood Co.
Pawling & Harnischfeger Co.

Explosives
Atlas Powder Co.
E. I. du Pont de Nemours & Co.

Hammer Drills
Ingersoll-Rand Co.

Heaters, Asphalt & Tar
Connery & Co., Inc.
Farasey, J. D., Mfg. Co.
Honhorst, Jos., Co.

Hoists
Ingersoll-Rand Co.
S. Flory Mfg. Co.
Pawling & Harnischfeger Co.
Schramm, Chris. D., & Son

Hoists, Hydraulic and Hand for Motor Trucks
Heil Co.

Hose
Goodyear Tire & Rubber Co.

Jacks, Lifting
The Duff Mfg. Co.

Kettles, Asphalt & Tar
Connery & Co., Inc.
Honhorst, Jos., Co.

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Conant Machine Co.

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Wyckoff Pipe & Creo. Co., Inc.

Metal Lath
Truscon Steel Co.

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Avery Co.
Tiffin Wagon Co.

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Ruberoid Co.
Servicised Products Co.

Paving Mixers
Koehring Co.
Ransome Concrete Mach. Co.

Picks
Wyoming Shovel Works

Piles (Creosoted)
Wyckoff Pipe & Creo. Co., Inc.

Plain Splice Bars
Sweet's Steel Co.

Plows
Avery Co.
Burch Plow Works Co.
Russell Grader Mfg. Co.
Wiard Plow Co.

Pneumatic Concrete Mixers and Placers
Ransome Concrete Mach. Co.

Pneumatic Tools
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Reinforcing Steel
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Sweet's Steel Co.

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Detroit Trailer Co.
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Track Bolts
Sweet's Steel Co.

Trucks, Commercial
Tiffin Wagon Co.

Turn Tables
American Bridge Co.
Western Structural Co.

DANGER SIGNALS
Ingram-Richardson Mfg. Co.

FIRE DEPARTMENT EQUIPMENT

Combination Chemical and Hose Wagons
American-La France Fire Engine Co.

Fire Alarm System
Loper Fire Alarm Co.

Fire and Chemical Hose
Goodyear Tire & Rubber Co.

Pumping Engines Gasoline
American-La France Fire Eng. Co.

Tires
Goodyear Tire & Rubber Co.

Triple Combination Motor
American-La France Fire Engine Co.

MISCELLANEOUS

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F. Weber Co.

Engineering Supplies
F. Weber Co.

Tanks, Welded Steel
Heil Co.

Transits and Levels
F. Weber Co.

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Air Compressors, Portable
Ingersoll-Rand Co.

Asphalt Block Press
Nat'l Moulding Press Corp.

Asphalt Distributors
Cressy Road Sprayer Mfg. Co.
Etnyre, E. D., Co.

Asphalt Plants
Cummer & Son Co.
Farasey, J. D., Mfg. Co.
Hetherington & Berner
Warren Bros. Co.

Car Unloaders
Acme Road Mchy. Co.
Burch Plow Works Co.
Good Rds. Mchy. Co., Inc.

Concrete Mixers
Good Rds. Mchy. Co., Inc.
Jaeger Mch. Co., The
Koehring Co.
Ransome Concrete Mach. Co.
Republic Iron Works
Schramm, Chris. D., & Son

Culverts, Corrugated Metal
Newport Culvert Co.

Gravel Screening Plants and Loaders
L. P. Green
Russell Grader Mfg. Co.

Heaters
Honhorst, Jos., Co.

Oil Distributors and Sprayers
Acme Road Mach. Co.
Austin-West. Rd. Mach. Co.
Connery & Co., Inc.
Cressy Road Sprayer Mfg. Co.
Etnyre, E. D., Co.
Good Rds. Mchy. Co., Inc.
The Kinney Mfg. Co.

Paving Breakers
Ingersoll-Rand Co.

Picks
Wyoming Shovel Works

Pumps—Oil and Asphalt
The Kinney Mfg. Co.

Road Graders
Acme Road Mchy. Co.
Austin-West. Rd. Mach. Co.
Ball Engine Co.
Erie Steam Shovel Co.
Good Rds. Mchy. Co., Inc.
Russell Grader Mfg. Co.

Road Drags
Acme Road Mchy. Co.
Austin-West. Rd. Mach. Co.
Good Rds. Mchy. Co., Inc.
Russell Grader Mfg. Co.

Road Levellers
Holt Mfg. Co., Inc.

Road Maintainers
Avery Co.
Austin-West. Rd. Mach. Co.
Russell Grader Mfg. Co.

Road Pavement Testing Machines
Ingersoll-Rand Co.

Road Rollers
Acme Road Mchy. Co.
Avery Co.
Austin-West. Rd. Mach. Co.
Buffalo-Springfield Rol. Co.
Good Rds. Mchy. Co., Inc.

Rock Crushers
Acme Road Mchy. Co.
Austin-West. Rd. Mach. Co.
Good Rds. Mchy. Co., Inc.

Rock Drills
Ingersoll-Rand Co.
Schramm, Chris. D., & Son
Sullivan Mchy. Co.

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Avery Co.
Buffalo-Springfield Rol. Co.
Good Rds. Mchy. Co., Inc.
Russell Grader Mfg. Co.

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Austin-West. Rd. Mach. Co.
L. P. Green
Good Rds. Mchy. Co., Inc.
Root Spring Scraper Co.
Russell Grader Mfg. Co.
Smith & Sons Mfg. Co.

Screens
Acme Road Mach. Co.
Good Rds. Mchy. Co., Inc.
L. P. Green
Russell Grader Mfg. Co.

Shovels
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Spreaders
Acme Road Mach. Co.
Burch Plow Works Co.

Tar Kettles, Asphalt Heaters, etc.
Acme Road Mchy. Co.
Connery & Co., Inc.
Cressy Road Sprayer Mfg. Co.
Honhorst, Jos., Co.
The Kinney Mfg. Co.
Standard Steel Works
Warren Bros. Co.

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Heltzel Steel Form & Iron Works
Standerd Steel Works

Tractors
Avery Co.
Holt Mfg. Co., Inc.

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Western Structural Co.

Wagon Loaders
Conant Machine Co.

PAVING MATERIALS

Asphalt
Servicised Products Co
Standard Oil Co. (Ind.)
Standard Oil Co., (N. Y.)
Texas Co.

Binders
Barrett Co., The
Standard Oil Co. (Ind.)
Standard Oil Co., (N. Y.)
Texas Co.

Bituminous Pavements
Barrett Co., The
Texas Co.
Warren Bros. Co.

Contraction Joints
Truscon Steel Co.

Creosoted Wood Block
Republic Creo. Co.
Wyckoff Pipe & Creo. Co., Inc.

Culverts, Corrugated Metal
Newport Culvert Co.

Curb Bars
Truscon Steel Co.

Expansion Joints
Barrett Co., The
Philip Carey Co.
Servicised Products Co
Truscon Steel Co.

Fluxing Asphaltums
Staodard Oil Co. (Ind.)

Oil (Roads)
Barrett Co., The
Headley Good Roads Co.
Standard Oil Co. (Ind.)
Standard Oil Co. (N. Y.)
Texas Co.

Paving Fillers
Standard Oil Co. (Ind.)

Reinforcing Mesh
Truscon Steel Co.

SEWERAGE

Culverts
Burch Plow Works Co.
The Robinson Clay Prod.
Russell Grader Mfg. Co.

Culverts, Corrugated Metal
Newport Culvert Co.

Drain Tile
Robinson Clay Prod. Co.

Joint Compound (Bituminous)
Ruberoid Co.

Pipe (Cast Iron)
Nat'l Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdry. Co.
R. D. Wood & Co.

Pipe Cleaning Machines
W. H. Stewart

Pipe (Reinfr. Concrete)
Independent Con. Pipe Co.

Segment Block Sewer
Robinson Clay Prod. Co.

Sewage Disposal Plants
Sanitation Corporation

Sewage Disinfection
Electro Bleaching Gas Co.

Rods
The F. Bissell Co.
W. H. Stewart

Vitrified Fire Clay Sewer Tiles
East Ohio Sewer Pipe Co.
Robinson Clay Prod. Co.

Vitrified Sewer Pipe
Ohio Vitrified Pipe Co.
Robinson Clay Prod. Co.

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Columbia Wagon & Body Co
Tiffin Wagon Co.

Garbage Bodies, Steel
Columbia Wagon & Body Co.
Heil Co., The

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Wm. E. Dee Co.
South Bend Foundry Co.

Incinerators
Stacy-Bates Co.
Vulcan Incinerator Co.

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Tiffin Wagon Co.

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Penn Salt Mfg. Co.

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Ingersoll-Rand Co.

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Thompson Meter Co.
Union Water Meter Co.

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Pittsburgh Meter Co.

Meter Testing Machines
H. W. Clark Co.
Mueller, H., Mfg. Co.
Pittsburgh Meter Co.

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National Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pipe, Steel
East Jersey Pipe Co.

Pipe, Wood
A. Wyckoff & Son Co.
Wyckoff Pipe & Creo.Co.,Inc.

Pumps
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Cook, A. D.
Schramm, Chris. D., & Son
Sullivan Mchy. Co.

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Schramm, Chris. D., & Son
Sterling Engine Co.

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Cook, A. D.

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Coldwell-Wilcox Co.

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Smith, A. P., Mfg. Co.

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Honhorst, Jos., Co.

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Cook, A. D.

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